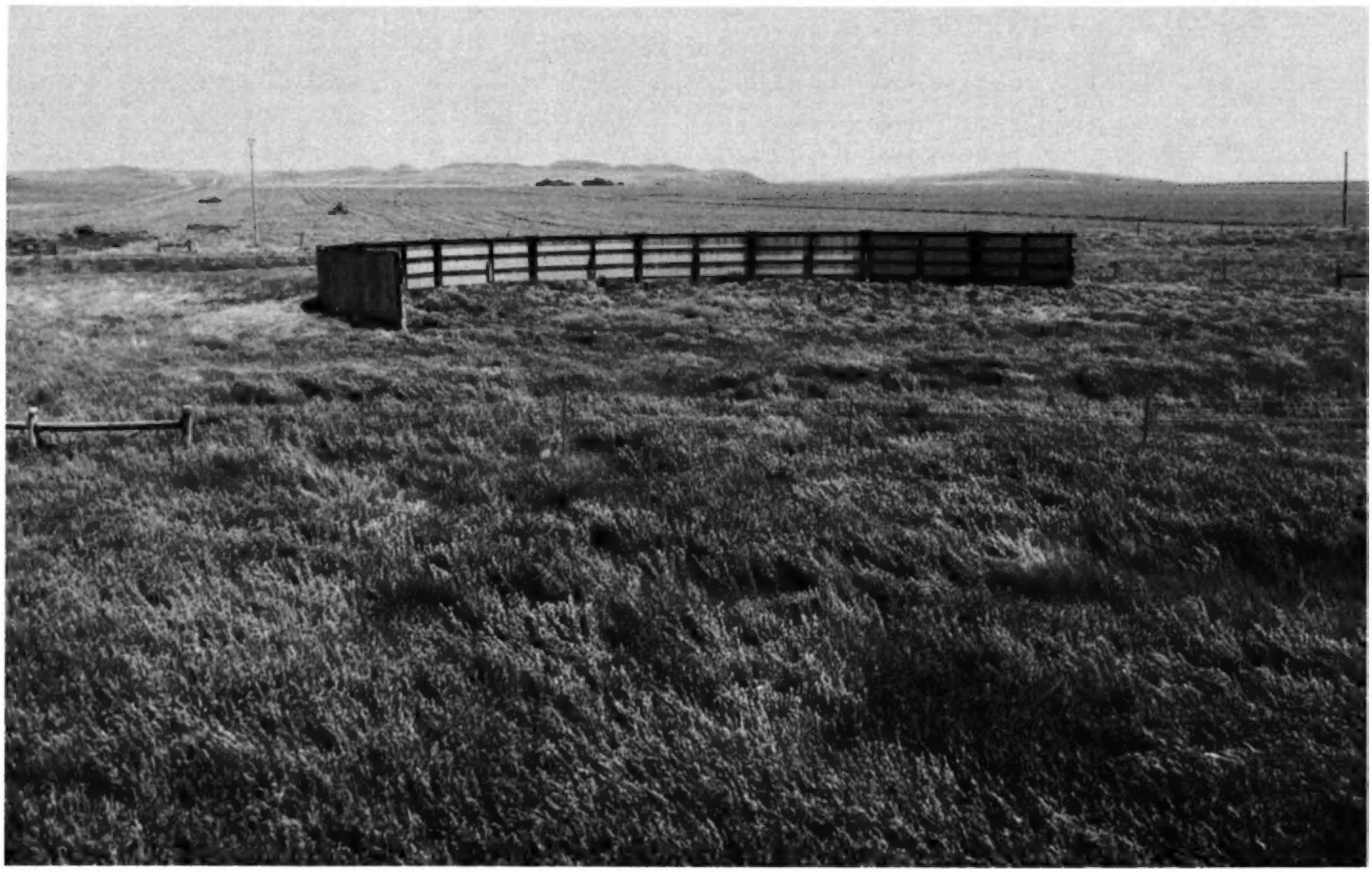
SOIL SURVEY OF

Butte County, South Dakota



United States Department of Agriculture
Soil Conservation Service
in cooperation with
South Dakota Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was done in the period 1958-1969. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the South Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Butte Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Butte County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the windbreak group and range site to which the soil has been assigned.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units, range sites, windbreak groups, and pasture groups.

Foresters and others can refer to the section "Woodland and Windbreaks," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range and, also, the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Engineering Uses of the Soils."

Engineers and builders can find under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Butte County may be particularly interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: Sheep stockade in Cabbart-Absher association. Soils in foreground are Belfield-Oburn silt loams, 0 to 3 percent slopes.

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SOIL SURVEY OF BUTTE COUNTY, SOUTH DAKOTA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

BUTTE COUNTY is in the northwestern part of South Dakota (fig. 1). It covers an area of about 1,450,240 acres, of which 10,560 acres is water areas more than 40 acres in size. Belle Fourche, the county seat and largest town, is in the southwestern part of the county. Other towns and villages are Fruitdale, Newell, Nisland, and Vale. Post offices and rural stores are at Arpan, Castle Rock, and Hoover.

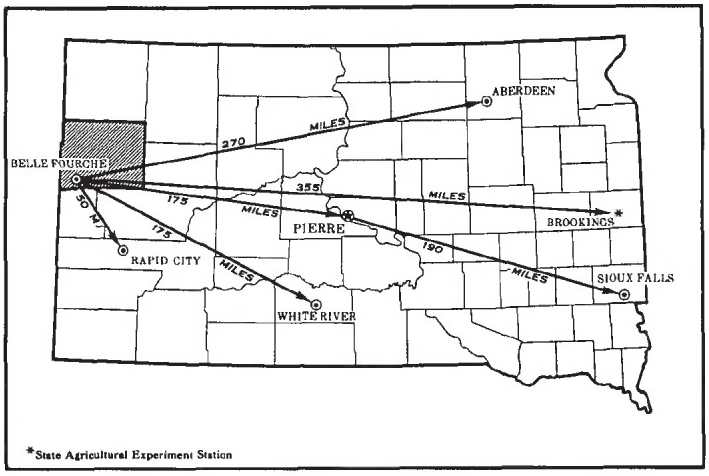

Figure 1.—**Location of Butte County in South Dakota.**

Butte County is in the Great Plains physiographic province. The relief is gently sloping to strongly sloping in most parts of the county. It is steep in rough, broken areas on the outer hogback of the Black Hills in the southwestern part of the county, the sides of scattered buttes and ridges, and the sides of entrenched stream valleys. About two-thirds of the county is drained by the Belle Fourche River. The northeastern and north-central parts are in the Moreau River drainage system.

Livestock ranching is the main farm enterprise. Irrigation is important in the southern part of the county and provides a stable feed base for the livestock industry. About 90 percent of the county is used for grazing. About 5 percent is dryfarmed cropland, and about 4 percent is irrigated cropland. Winter wheat is the main dryfarmed crop. Alfalfa, corn, and edible beans are the main irrigated crops. Oats and barley also are grown.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Butte County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* (*8*)[2] are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Twilight and Zeona, for example, are the names of two soil series. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

[1] Others who contributed to the fieldwork are EDGAR H. ENSZ, ROBERT E. RADEKE, and DENNIS TEKRONY, Soil Conservation Service, United States Department of Agriculture.

[2] Italic numbers in parentheses refer to Literature Cited, p. 151.

On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Caputa loam, 0 to 2 percent slopes, is one of several phases within the Caputa series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Three such kinds of mapping units are shown on the soil map of Butte County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Cabbart-Scroggin loams, 6 to 25 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Lakoa-Colby association, 9 to 50 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Glenberg and Haverson soils is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Badland is a land type in Butte County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is completed when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and range, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations of Butte County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map that shows soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The 12 soil associations in this survey have been grouped into four general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described on the following pages.

Well Drained to Excessively Drained, Nearly Level to Steep Soils Formed in Material Derived From Clay Shale on Uplands

In this group are clayey and silty soils formed in material weathered from clay shale. Clay is the dominant soil texture. Most of the soils in this group

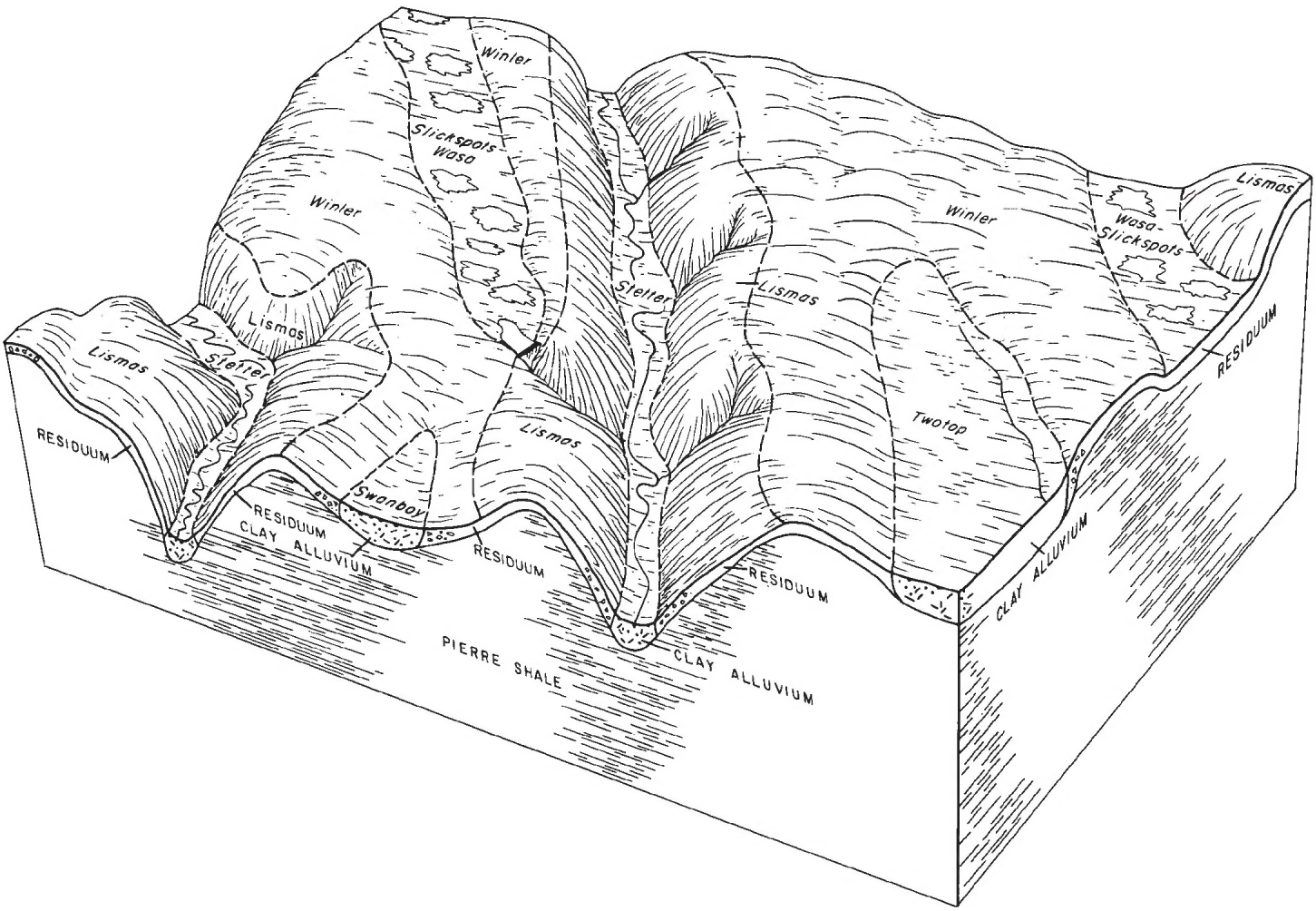

Figure 2.—**Typical pattern of soils and parent material in soil association 1.**

have very slow permeability and a limited root zone. Most areas are in native grass and are used for range.

1. Winler-Lismas association

Moderately deep and shallow, nearly level to moderately steep clayey soils over clay shale

This association is on broad uplands that extend from the northwestern corner to the southeastern corner of the county. It is mostly gently sloping to sloping. Steeper soils are on the sides of ridges, buttes, and entrenched drainageways.

This association makes up about 39 percent of the county. It is about 35 percent Winler soils, 25 percent Lismas soils, and 40 percent less extensive soils (fig. 2).

Winler soils are nearly level to sloping. They are grayish-brown clay that is moderately deep over clay shale. The surface layer has a platy crust in the upper one-half inch. The subsoil is extremely hard when dry, very firm when moist, and sticky and plastic when wet. Spots and streaks of gypsum and other salts commonly are below a depth of 12 inches. Permeability is very slow, and available water capacity is low or very low.

Lismas soils are gently sloping to moderately steep and are on the tops and sides of ridges and on the shoulders of drainageways. They have a surface layer of grayish-brown clay. The underlying material is light brownish-gray clay and shaly clay to a depth of 16 inches and clay shale below. Permeability is very slow, and available water capacity is very low.

Slickspots and Wasa soils, mainly on upland flats and in slight depressions, are the most common of the less extensive soils and land types in the association. Others are Bidman, Redig, and Schamber soils on isolated terrace remnants scattered throughout the association; Hisle soils in drainage sags and on foot slopes; Kyle, Swanboy, and Twotop soils on terraces and fans; gently sloping to moderately steep Pierre soils on ridges; Stetter soils and Saline alluvial land on bottom land along drainageways; Saline-Alkali land on upland flats and in sidehill seep areas; and Stony steep land in the vicinity of Two Top and Antelope Buttes.

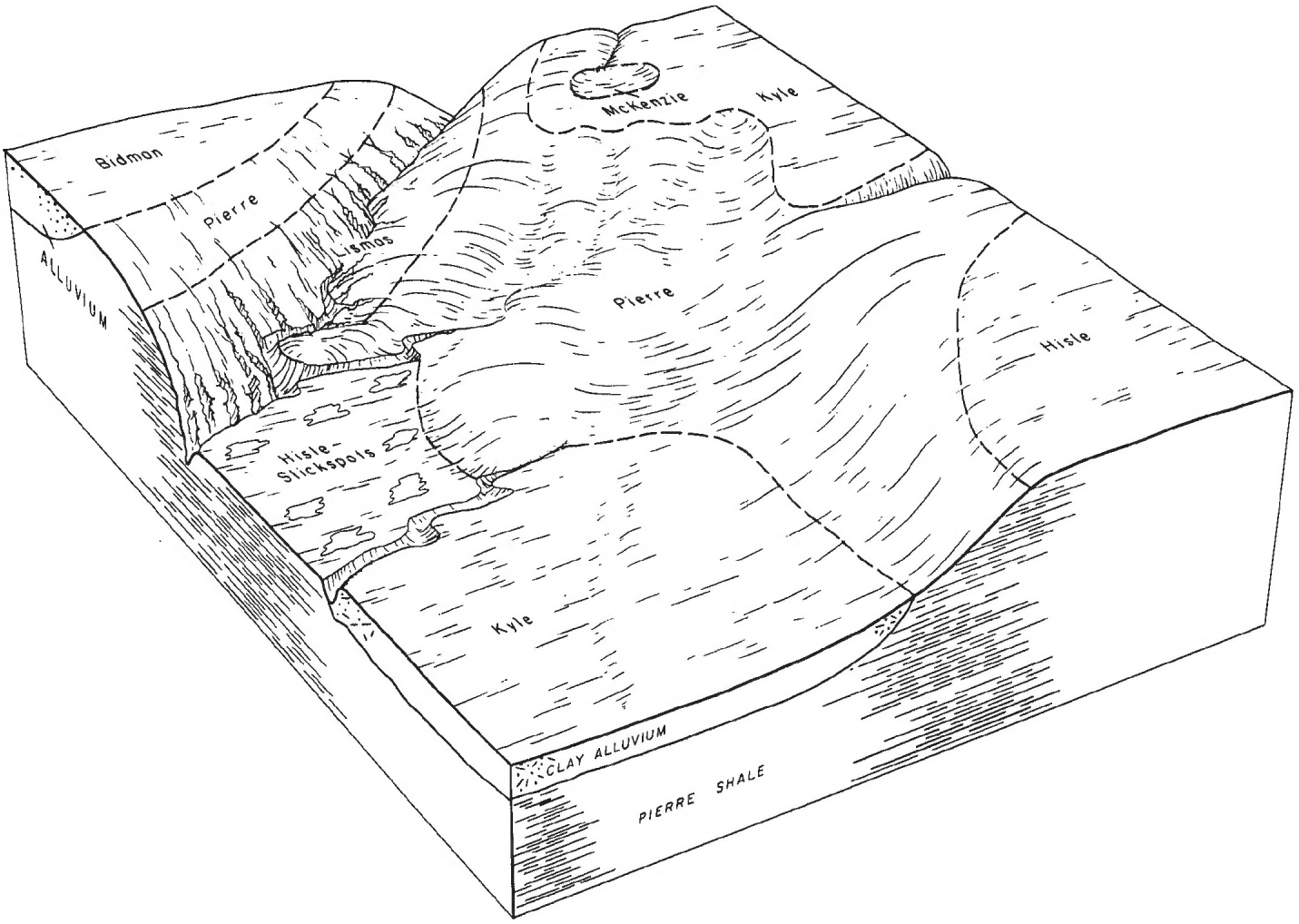

Figure 3.—**Typical pattern of soils and parent material in soil association 2.**

The very fine texture, extremely hard consistence, very slow permeability, and low or very low available water capacity of the major soils limit the use of this association. Surface runoff is medium to very rapid, and the areas are subject to erosion.

Almost all the association is in native vegetation and is used for range. The native vegetation is mainly a sparse stand of mid grasses and very little or no understory of sod-forming short grasses.

2. *Pierre-Kyle association*

Moderately deep and deep, nearly level to moderately steep clayey soils over clay shale

This association is on uplands. It is mostly nearly level to sloping. Steeper soils are on the sides of ridges and on the shoulders of entrenched drainageways. Slopes are relatively long except on the sides of the drainageways.

This association makes up about 15 percent of the county. It is about 40 percent Pierre soils, 30 percent Kyle soils, and 30 percent less extensive soils (fig. 3).

Pierre soils are mostly gently sloping to moderately steep. They are grayish-brown clay that is moderately deep over shale. The subsoil is very hard when dry, very firm when moist, and very sticky and plastic when wet, and is calcareous below a depth of 8 inches. Spots of soft lime are below a depth of 18 inches. Permeability is very slow, and available water capacity is low or very low.

Kyle soils are mostly nearly level and gently sloping and are on upland flats and fans and on terraces. They are similar to Pierre soils, but are more than 40 inches deep over shale. Permeability is very slow, and available water capacity is low or moderate.

Less extensive soils in the association are Arvada and Twotop soils on some terraces and fans; Bidman, Redig, and Schamber soils on isolated terrace remnants scattered throughout the association; Hisle soils and Slickspots on upland flats and in slight depressions; Lismas soils on the steep sides of ridges and entrenched drainageways; McKenzie soils in closed depressions; Stetter soils on bottom

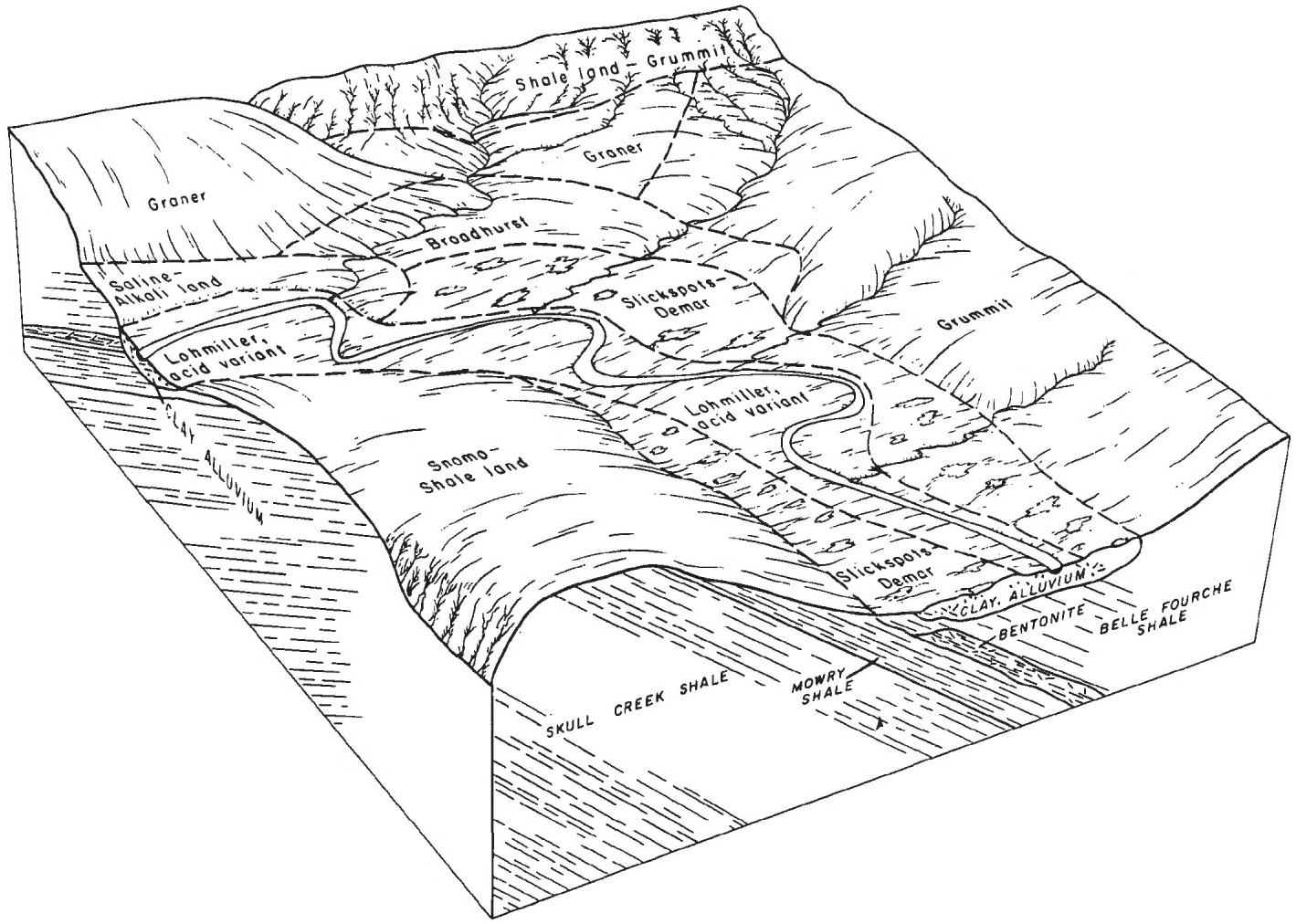

Figure 4.—**Typical pattern of soils and parent material in soil association 3.**

land along drainageways; and Winler soils in areas that are in transition to the Winler-Lismas association.

The very slow permeability, poor tilth, and moderate to very low available water capacity of the major soils limit the use and management of this association. Cultivated areas are subject to erosion and soil blowing. Drainage is a major management need in irrigated areas.

Many areas are in native grass and are used as range. The native vegetation is mainly mid and short grasses. The major dryfarmed areas are east of Castle Rock and north of Arpan. Winter wheat is the main crop in these areas. The main irrigated areas are in the vicinity of Arpan and Newell. Alfalfa is the main irrigated crop.

3. *Grummit-Shale land association*

Shallow, gently sloping to steep clayey soils over acid clay shale, and Shale land

This association is on uplands. It is mostly gently sloping to moderately steep. Steeper soils are on the sides of some ridges, on the sides of eroding drainageways, and in rough broken areas along the Belle Fourche River west of the city of Belle Fourche.

This association makes up about 4 percent of the county. It is about 25 percent Grummit soils, 20 percent Shale land, and 55 percent less extensive soils (fig. 4).

Grummit soils are gently sloping to steep. They have a surface layer of light brownish-gray clay. The underlying material is grayish-brown clay and shaly clay to a depth of 17 inches and brittle acid shale below. The soil contains fine fragments of shale, is acid in reaction, and is friable throughout the profile. Permeability is moderate above the shale, and the available water capacity is very low.

Shale land in this association is eroding exposures of brittle acid shale on the sides of ridges and around the heads of eroding drainageways.

Snomo soils, mainly in areas of mixed forest and grass, are the most common of the less extensive soils and land types in the association. Others are

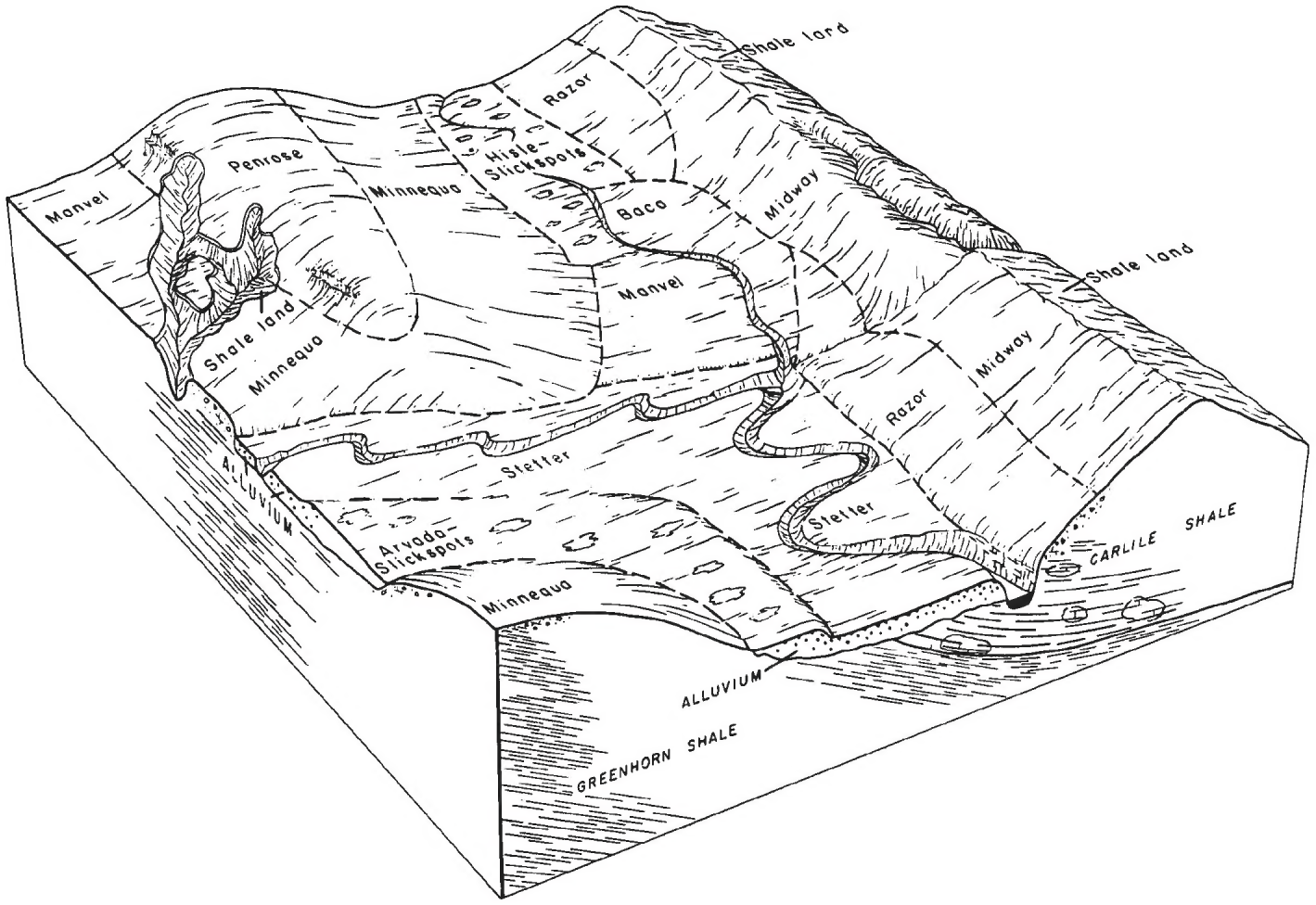

Figure 5.—**Typical pattern of soils and parent material in soil association 5.**

Broadhurst and Demar soils along with Slickspots on terraces and fans; gently undulating to hilly Graner soils on uplands; Lohmiller acid variant soils on bottom land along the larger drainageways; Saline-Alkali land on some fans; and Mine pits and dumps in areas of bentonite stripmining operations.

The shallow depth and very low available water capacity of the Grummit soil limit the use of this association. Control of erosion and soil blowing is a major concern of management.

Almost all of this association is in native vegetation and is used for range. The native vegetation on some of the Shale land and in areas of Snomo soils includes scattered stands of bur oak and ponderosa pine. The underlying shale in parts of the association is a source of bentonite.

4. Epsie association

Shallow, gently sloping to steep clayey soils over saline clay shale

This association is in several areas on both sides of Indian Creek north of Belle Fourche. It is mostly strongly sloping to hilly. Some gently sloping and steep soils also occur. Many entrenched drainageways dissect the landscape.

This association makes up about 3 percent of the county. It is about 80 percent Epsie soils, 15 percent Shale land, and 5 percent less extensive soils.

Epsie soils have a thin surface layer of calcareous, light olive-gray clay. The underlying material is calcareous clay and shaly clay that extends to a depth of 14 inches. Gray shale is below a depth of 14 inches. These soils are high in content of salts and

contain fine shale fragments. Permeability is very slow, and available water capacity is very low.

Shale land is on narrow ridgetops and on the steep sides of ridges and entrenched drainageways. It consists of outcrops of very saline shale.

Less extensive soils in this association are Swanboy and Wasa soils on foot slopes and fans in the lower parts of the landscape.

The shallow depth and high salt content limit the use of this association to grazing. Surface runoff is rapid or very rapid, and the areas are subject to erosion.

All the areas are used for range. The native vegetation is a sparse stand of salt-tolerant forbs and grasses.

Well-drained, Gently Sloping to Moderately Steep Soils Formed in Material Derived From Shale and Limestone on Uplands

In this group are silty soils formed in material weathered from clayey to silty shale and limestone. The shallow root zone of the major soils limits the use and management of the areas. Erosion and soil blowing are hazards in areas where plant cover is not adequate. Most areas are in native grass and are used for range. Some areas of the less extensive soils are cultivated, and some of these are irrigated.

5. Midway-Penrose association

Shallow, gently sloping to moderately steep silty soils over shale and limestone

This association is in scattered areas. It is mostly gently sloping to strongly sloping. Moderately steep soils are on the sides of some ridges.

This association makes up about 8 percent of the county. It is about 20 percent Midway soils, 18 percent Penrose soils, and 62 percent less extensive soils (fig. 5).

Midway soils are underlain by clayey shale. They have a surface layer of calcareous, light brownish-gray silty clay loam. The underlying material is calcareous, grayish-brown silty clay loam to a depth of 13 inches and light-gray shale below. Permeability is slow, and available water capacity is very low.

Penrose soils are underlain by calcareous shale that is interbedded with thin, discontinuous layers of brittle limestone. They are similar to Midway soils, but contain less clay and have a high content of lime. Permeability is moderately slow, and available water capacity is very low.

Less extensive in the association are Arvada soils and Slickspots on terraces; Baca and Razor soils on fans and the sides of ridges below Midway soils; Hisle soils and Slickspots in drainage sags and foot slopes on uplands; Manvel soils on terraces and fans below Penrose soils; Minnequa soils on the sides of ridges below or intermingled with Penrose soils; and Stetter soils on bottom land along drainageways.

The shallow root zone, low fertility, and very low available water capacity of the major soils limit the use and management of this association. Surface runoff is medium to rapid, depending on soil slope. Erosion and soil blowing are hazards in areas where plant cover is not adequate.

Most areas are in native grass and are used for range. Some minor soils are cultivated, and some are irrigated. Winter wheat is the main dryfarmed crop. Alfalfa is the main irrigated crop.

Well Drained to Excessively Drained, Nearly Level to Very Steep Soils Formed in Material Derived From Siltstone, Sandstone, and Shale on Uplands

In this group are loamy and silty soils and claypan soils formed in material weathered from siltstone, sandstone, and shale. Steep slopes and the shallow root zones limit the use and management of these soils. Erosion and soil blowing are hazards in areas where plant cover is not adequate. Most areas are in native grass and are used for range, but small isolated areas are used for dryland farming.

6. Cabbart-Absher association

Shallow, sloping to steep loamy soils over shale, siltstone, and sandstone, and deep, nearly level to sloping loamy soils that have a claypan

This association is on uplands. It is mostly sloping to moderately steep. Steeper soils are on the sides of ridges and buttes, and nearly level soils are on terraces along drainageways and on upland drainage divides.

This association makes up about 4 percent of the county. It is about 30 percent Cabbart soils, 20 percent Absher soils, and 50 percent less extensive soils.

Cabbart soils are sloping to steep and are on the tops and sides of ridges and buttes. They are shallow, calcareous soils that have a thin surface layer of yellowish-brown loam. The underlying material is light brownish-gray and light-gray loam. Interbedded siltstone and sandstone are at a depth of 13 inches. Permeability is moderate above the bedrock, and available water capacity is very low.

Absher soils are nearly level to sloping and are on terraces, fans, and upland flats. They are deep soils that have a thin surface layer of fine sandy loam underlain by a claypan subsoil of clay loam. Permeability is very slow, and available water capacity is moderate.

Less extensive in the association are Assiniboine, Blackhall, and Twilight soils in some areas underlain by sandstone; Belfield and Oburn soils on some terraces and fans; Lismas soils on the sides of some ridges and entrenched drainageways; loamy alluvial land along drainageways; Ralph and Scroggin soils on the sides of ridges intermingled with and below Cabbart soils; Slickspots in areas of Absher soils; and, in some areas, Badland and Stony steep land on the sides of some ridges and buttes.

The shallow root zone and very low available water capacity of the Cabbart soil and the very slow permeability and poor tilth of the Absher soil limit the use of this association mainly to range. Control

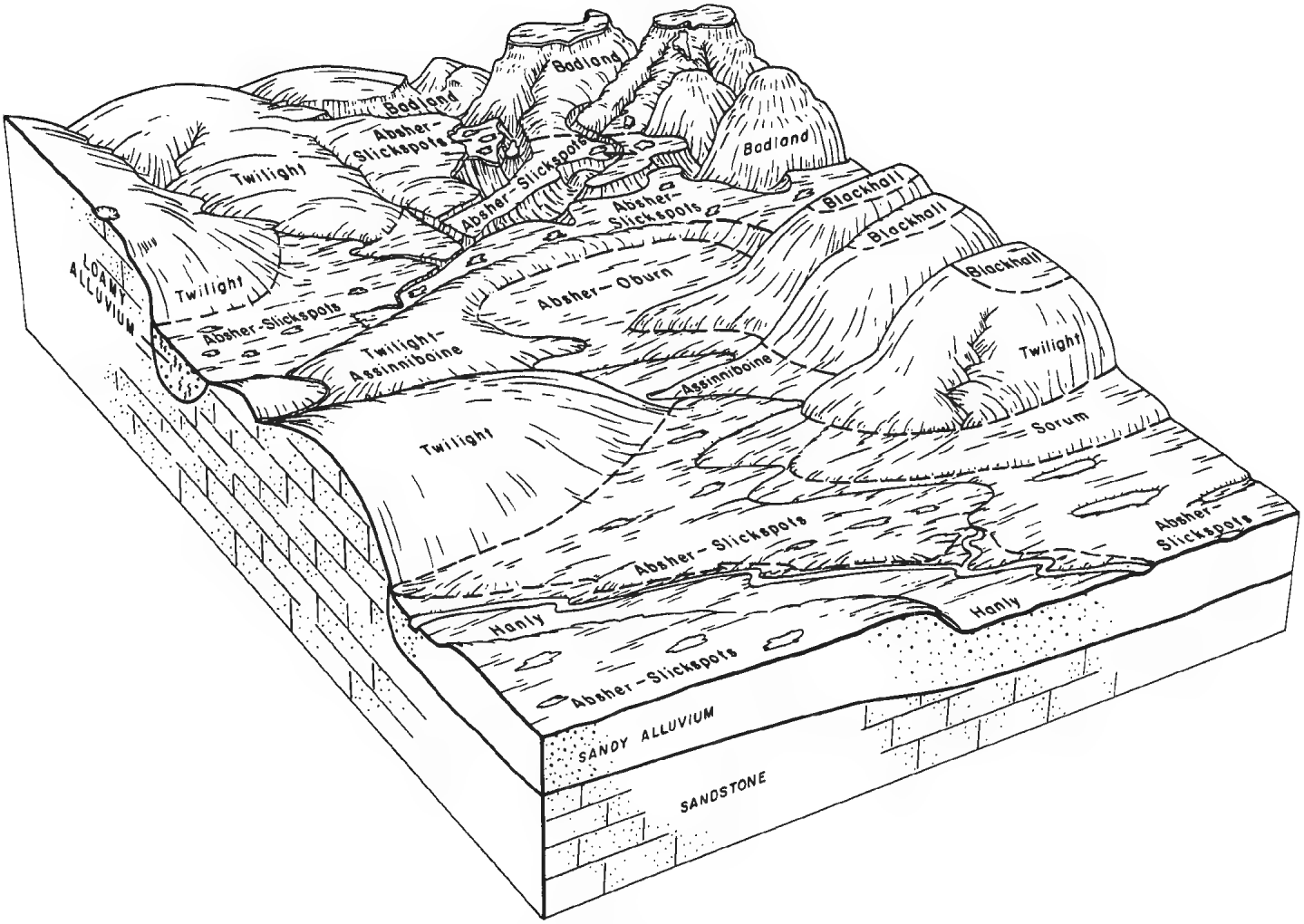

Figure 6.—**Typical pattern of soils and parent material in soil association 7.**

of erosion is a concern of management in areas where plant cover is not adequate.

Most areas are in native grass and are used for range. A few areas of some of the less extensive soils are cultivated. Small grain and alfalfa are the main crops.

7. *Twilight-Absher association*

Moderately deep, gently sloping to moderately steep loamy soils over sandstone, and deep, nearly level to sloping loamy soils that have a claypan

This association is on uplands. It is mostly gently sloping to moderately steep. Some nearly level soils are on terraces along drainageways, and a few steep soils are on the sides of buttes and entrenched drainageways. In places drainageways have cut deeply into the landscape.

This association makes up about 9 percent of the county. It is about 35 percent Twilight soils, 15 percent Absher soils, and 50 percent less extensive soils (fig. 6).

Twilight soils are gently sloping to moderately steep and are on the sides of ridges and knolls. They have a thin surface layer of brown fine sandy loam and a subsoil of brown and light brownish-gray fine sandy loam. The underlying material is calcareous, light-gray fine sandy loam to a depth of 28 inches and calcareous sandstone below. Permeability is moderately rapid, and available water capacity is low.

Absher soils are nearly level to sloping and are on terraces, fans, and upland flats. They are deep soils that have a thin surface layer of fine sandy loam and a claypan subsoil of clay loam. Permeability is very slow. Tilth is poor.

Less extensive in the association are Archin, Belfield, and Sorum soils on fans and terraces; Assiniboine and Ralph soils on the lower sides of ridges in the less sloping parts of the association; Blackhall soils on the tops and steep sides of ridges and knolls; Cabbart and Scroggin soils on some of the more silty ridges and knolls; Hanly soils on bottom land; Oburn and Parshall soils in drainage sags and on terraces and fans; Zeona soils in the more undulating and more sandy parts of the association; Bad-

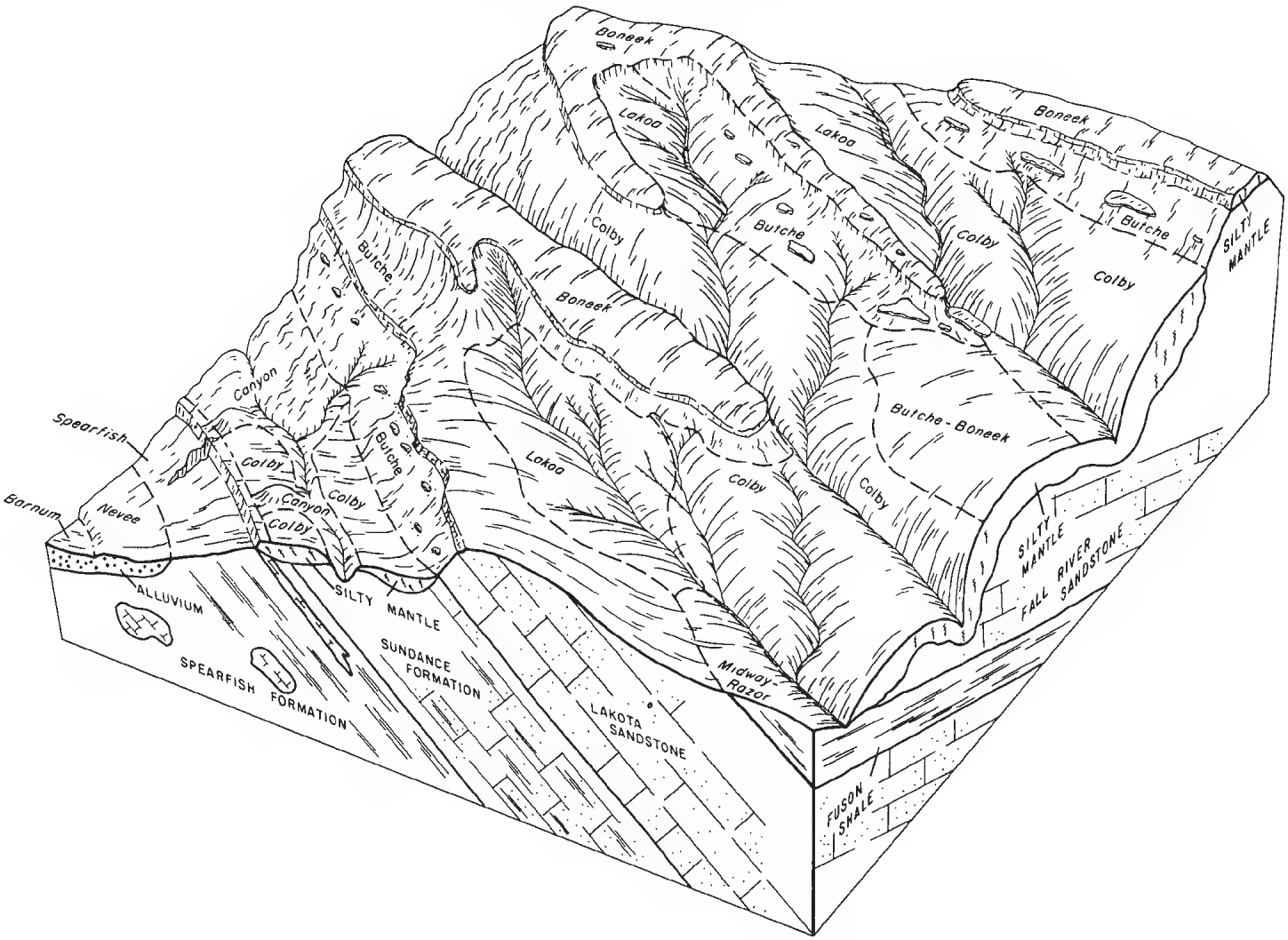

Figure 7.—**Typical pattern of soils and parent material in soil association 8.**

land on the sides of some buttes; and Loamy alluvial land and Saline alluvial land on some bottom land.

The low available water capacity and low fertility of the Twilight soil and the very slow permeability and poor tilth of the Absher soil limit the use of this association mainly to grazing. Soils of this association are highly susceptible to soil blowing. Erosion is a hazard on sloping soils.

Most areas are in native grass and are used for range. Only a few areas of some of the less extensive soils are cultivated. Small grain and alfalfa are the main crops.

8. Butche-Colby association

Shallow to deep, sloping to very steep loamy and silty soils over siltstone, sandstone, and shale

This association is mainly on a broad uplift ridge that has angular slopes on the side facing the Redwater River and long dip slopes on the north side. The association is mostly sloping to very steep. Nearly level and gently sloping soils are on bottom land, terraces, and upland divides. Drainageways are deeply entrenched.

This association makes up about 2 percent of the county. It is about 20 percent Butche soils, 20 percent Colby soils, and 60 percent less extensive soils (fig. 7).

Butche soils are sloping to very steep and are mostly in the higher parts of the landscape. They have a thin surface layer of brown very fine sandy loam. The underlying material is light yellowish-brown very fine sandy loam. Interbedded siltstone and sandstone are below a depth of 16 inches. Permeability is moderate above the bedrock, and available water capacity is very low.

Colby soils are sloping to steep. They commonly are in the lower parts of the landscape, but also are scattered throughout some of the higher areas. They are deep silty soils that have a thin surface layer of brown silt loam. The underlying material is calcareous, light-gray and white silt loam to a depth of 42 inches and calcareous, light-gray loamy very

fine sand below. Permeability is moderate, and available water capacity is moderate or high. These soils are low in fertility and are highly susceptible to erosion and soil blowing.

Among the less extensive soils in the association are Boneek soils on high terraces and upland divides; Canyon soils on the tops and sides of ridges that are underlain by calcareous sandstone; Keith soils on terraces and fans; and Lakoa soils in forested areas near Butche and Colby soils. Each of these soils makes up as much as 10 percent or more of the association. Other less extensive soils and land types are Barnum and Haverson soils on bottom land and low terraces; Midway and Razor soils in areas underlain by clayey shale; Nevee soils on fans and foot slopes below Spearfish soils; Rock outcrop in and near areas of Butche, Canyon, and Spearfish soils; and Spearfish soils on the tops and steep sides of ridges near Redwater River.

Steep slopes and the shallow root zone of the Butche soils and many of the less extensive soils limit the use of this association. Surface runoff is medium to rapid, depending on soil slope. Most areas are subject to erosion.

Most areas are in native vegetation and are used for range. The native vegetation includes scattered stands of ponderosa pine and bur oak. Some areas of the less extensive soils are cultivated, and some of these are irrigated. Winter wheat is the main dryfarmed crop. Alfalfa, corn, and small grain are the main irrigated crops.

Well-drained, Nearly Level to Sloping Soils Formed in Alluvium on Terraces and Bottom Land

In this group are loamy and clayey soils formed in alluvium. These soils are susceptible to soil blowing in areas where plant cover is not adequate. The sloping soils are subject to erosion. The major cropland soils of the county are in this group. Some areas also are used for range and hay.

9. Arvada-Stetter association

Deep, nearly level silty soils that have a claypan and are on terraces, and deep, nearly level clayey soils on bottom land

This association is mainly along the South Fork of Moreau River and along some of the larger creeks in the county. It is nearly level, but small low mounds and old channel meander scars make the surface uneven in some areas.

This association makes up about 6 percent of the county. It is about 40 percent Arvada soils, 30 percent Stetter soils, and 30 percent less extensive soils.

Arvada soils are on terraces and high bottoms. They are deep soils that have a thin surface layer of light brownish-gray silt loam and a claypan subsoil of silty clay. Spots and streaks of lime and other salts are in the lower part of the subsoil. Permeability is very slow. Tilth is poor.

Stetter soils are on bottom land. They are deep, grayish-brown clay. Permeability is slow. Most areas are subject to flooding.

Also prominent in areas of Arvada soils are Slickspots in slight depressions. Other less extensive soils are Glenberg, Haverson, and Lohmiller soils on bottom land and Kyle, Swanboy, and Twotop soils on terraces and fans.

The very slow permeability and poor tilth of the Arvada soil and the flooding hazard on the Stetter soil limit the use of this association.

Most areas are in native grass and are used for range and hay. Some areas of Stetter soils are cultivated. Alfalfa is the main crop.

10. Lohmiller-Glenberg-Haverson association

Deep, nearly level silty and loamy soils on bottom land and low terraces

This association is on bottom land and low terraces along Belle Fourche River and some of its tributaries. It is nearly level except for old floodwater channels and short-sloped rises at different levels in the stream valley.

This association makes up about 5 percent of the county. It is about 20 percent Lohmiller soils, 20 percent Glenberg soils, 10 percent Haverson soils, and 50 percent less extensive soils.

Lohmiller soils formed in clayey alluvium. They have a surface layer of grayish-brown silty clay loam. The underlying material is calcareous, light brownish-gray and grayish-brown silty clay loam. Permeability is slow, and available water capacity is moderate or high.

Glenberg soils formed in stratified sandy alluvium. They are calcareous, grayish-brown fine sandy loam to a depth of 35 inches and calcareous loamy sand below. They are highly susceptible to soil blowing. Permeability is moderately rapid, and available water capacity is moderate.

Haverson soils formed in loamy alluvium. They have a surface layer of calcareous, grayish-brown loam and silt loam. Below this is calcareous, stratified loam and silt loam. Permeability is moderate, and available water capacity is high.

Less extensive soils in this association are Barnum soils on bottom land along Redwater River and Altvan, Dix, Keith, Manter, Mawer, Minatare, Savo, Vale, and Whitelake soils on terraces and fans at the outer edges of stream valleys.

The major soils in this association are low in fertility. They have properties that are favorable for irrigation. Improving fertility and managing irrigation water are the main concerns of management. Soil blowing is a hazard in some areas.

Many areas are cultivated and irrigated. Corn, alfalfa, edible beans, barley, and oats are the main crops.

11. Caputa-Satanta association

Deep, nearly level to sloping loamy soils on high terraces

This association is on high terraces on upland drainage divides. It is mostly nearly level and gently sloping. Steeper soils are on the sides of some of the drainageways.

This association makes up about 2 percent of the county. It is about 35 percent Caputa soils, 25 percent Satanta soils, and 40 percent less extensive soils.

Caputa soils have a surface layer of dark-brown loam and a subsoil of grayish-brown and gray clay loam that is calcareous below a depth of 18 inches. The underlying material is calcareous, gray clay loam. Permeability is moderately slow, and available water capacity is moderate or high.

Satanta soils have a surface layer of grayish-brown loam. The upper part of the subsoil is brown clay loam, and the lower part is calcareous, grayish-brown sandy clay loam. The underlying material is calcareous, light brownish-gray loam. Permeability is moderate, and available water capacity is high.

Alice soils are the most common of the less extensive soils. They are in the more sandy parts of the association. Other less extensive soils are Altvan and Bidman soils on some of the high terraces, Grummit and Pierre soils in areas underlain by shale, and Redig and Schamber soils on the steep sides of drainageways and terrace escarpments.

Soils of this association are medium in fertility and have good tilth. Conservation of moisture is the main management concern on the nearly level soils. Control of erosion is a management concern on sloping soils. Soil blowing is a hazard in some areas.

Many areas are cultivated. Winter wheat is the main dryfarmed crop, but alfalfa and oats also are grown.

12. Sorum association

Deep, nearly level to gently sloping loamy soils that have a claypan and are on terraces

This association is on terraces and fans in stream valleys. It is mostly nearly level and gently sloping, but some areas have an uneven surface and some are gently undulating.

This association makes up about 3 percent of the county. It is about 35 percent Sorum soils and 65 percent less extensive soils.

Sorum soils have a thick surface layer of grayish-brown fine sandy loam, a thin subsurface layer of light brownish-gray fine sandy loam, and a claypan subsoil of clay loam. The underlying material is calcareous sandy loam. Permeability is very slow, and available water capacity is moderate or high.

Less extensive in the association are Archin and Absher soils on some of the terraces; Slickspots intermingled with Archin and Absher soils in slight depressions; and Zeona soils in undulating areas that have hummocky relief. These soils and land types, together with the Sorum soils, make up 85 percent or more of the association. All have a claypan except the Zeona soil. Less important among the less extensive soils are Assinniboine and Chinook soils on some terraces and fans; Hanly soils on bottom land; Oburn soils in some areas of Sorum soils; and Twilight soils on knolls and ridges.

The very slow permeability of the claypan subsoil limits the use of this association. Many of the soils are susceptible to soil blowing.

Most areas are in native grass and are used for range. Some areas are cultivated. Alfalfa and small grain are the main crops.

Descriptions of the Soils

This section describes the soil series and mapping units in Butte County. Each soil series is described in considerable detail and then, briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless otherwise stated, the colors given in the descriptions are those of a dry soil. Coarse fragments are reported as a percentage of the total volume of the soil material.

As mentioned in the section "How This Survey Was Made," not all mapping units are in a soil series. Riverwash, for example, does not belong to a soil series but, nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, windbreak group, and range site to which the mapping unit has been assigned. The page for the description of each capability unit, windbreak group, and range site can be found by referring to the "Guide to Mapping Units" at the back of this survey. Unless otherwise noted, the capability unit designations are for dryland conditions.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the back of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*8*).

Absher Series

The Absher series consists of deep, nearly level to sloping, well-drained loamy soils that have a claypan subsoil. These soils are on fans, terraces, and uplands. They formed in material weathered from sandstone, siltstone, and shale, either in place or washed in from nearby sloping soils.

In a representative profile the surface layer is grayish-brown fine sandy loam about 4 inches thick. The subsurface layer is light brownish-gray fine sandy loam about 1 inch thick. The subsoil, about 16

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Absher-Oburn complex, 0 to 3 percent slopes	3,560	0.3	Lismas clay, 3 to 25 percent slopes	143,317	9.9
Absher-Oburn complex, 3 to 9 percent slopes	12,663	.9	Lismas-Pierre clays, 3 to 18 percent slopes	7,264	.5
Absher-Slickspots complex, 0 to 9 percent slopes	56,057	3.8	Loamy alluvial land	3,155	.2
Alice fine sandy loam, 2 to 6 percent slopes	2,394	.2	Lohmiller silty clay loam, 0 to 2 percent slopes	9,853	.7
Alice fine sandy loam, 6 to 9 percent slopes	642	(1)	Lohmiller silty clay loam, 2 to 6 percent slopes	1,118	.1
Altvan loam, 0 to 2 percent slopes	1,655	.1	Lohmiller silty clay loam, saline	2,178	.2
Altvan loam, 2 to 6 percent slopes	305	(1)	Lohmiller silty clay loam, acid variant	1,604	.1
Archin-Slickspots complex, 0 to 3 percent slopes	11,724	.8	Manter fine sandy loam, 0 to 2 percent slopes	4,162	.3
Arvada silt loam, 0 to 3 percent slopes	13,000	.9	Manter fine sandy loam, 2 to 6 percent slopes	460	(1)
Arvada-Slickspots complex, 0 to 3 percent slopes	33,726	2.3	Manvel silty clay loam, 0 to 2 percent slopes	651	(1)
Assiniboine fine sandy loam, 0 to 3 percent slopes	1,607	.1	Manvel silty clay loam, 2 to 6 percent slopes	5,357	.4
Baca silty clay loam, 0 to 2 percent slopes	3,640	.3	Marsh	1,003	.1
Baca silty clay loam, 2 to 6 percent slopes	9,239	.6	Mawer fine sandy loam, 0 to 2 percent slopes	4,976	.4
Badland	9,684	.7	Mawer fine sandy loam, 2 to 6 percent slopes	521	(1)
Barnum silt loam	2,316	.2	McKenzie clay	1,940	.1
Barnum silt loam, channeled	500	(1)	Midway silty clay loam, 6 to 25 percent slopes	12,600	.9
Belfield-Oburn silt loams, 0 to 3 percent slopes	3,537	.3	Midway-Razor silty clay loams, 3 to 15 percent slopes	21,210	1.5
Belfield-Oburn silt loams, 3 to 6 percent slopes	5,467	.4	Minatare-Whitelake complex	800	.1
Bidman loam, 0 to 3 percent slopes	5,806	.4	Mine pits and dumps	1,872	.1
Bidman loam, 3 to 6 percent slopes	6,970	.5	Minnequa silty clay loam, 2 to 6 percent slopes	750	.1
Bidman-Redig complex, 2 to 9 percent slopes	6,098	.4	Minnequa silty clay loam, 6 to 9 percent slopes	1,552	.1
Boneek silt loam, 2 to 6 percent slopes	3,142	.2	Nevee silt loam, 2 to 6 percent slopes	960	.1
Boneek silt loam, 6 to 9 percent slopes	828	.1	Nevee-Spearfish silt loams, 6 to 25 percent slopes	780	.1
Broadhurst clay, 0 to 6 percent slopes	3,447	.2	Oburn loam, 0 to 3 percent slopes	1,036	.1
Butche-Boneek complex, 6 to 25 percent slopes	1,713	.1	Parshall fine sandy loam, 0 to 3 percent slopes	911	.1
Butche-Rock outcrop complex, 25 to 50 percent slopes	4,430	.3	Penrose silty clay loam, 6 to 25 percent slopes	10,969	.8
Cabbart loam, 25 to 40 percent slopes	2,375	.2	Penrose-Minnequa silty clay loams, 3 to 15 percent slopes	16,000	1.1
Cabbart-Lismas complex, 6 to 18 percent slopes	3,397	.2	Pierre clay, 0 to 2 percent slopes	1,324	.1
Cabbart-Rock outcrop complex, 25 to 50 percent slopes	14,003	1.0	Pierre clay, 2 to 6 percent slopes	38,876	2.7
Cabbart-Scroggin loams, 6 to 25 percent slopes	20,253	1.4	Pierre clay, 6 to 21 percent slopes	40,550	2.8
Canyon-Colby complex, 25 to 50 percent slopes	3,122	.2	Ralph loam, 3 to 6 percent slopes	4,327	.3
Caputa loam, 0 to 2 percent slopes	3,371	.2	Razor silty clay loam, 0 to 2 percent slopes	460	(1)
Caputa loam, 2 to 6 percent slopes	4,778	.3	Razor silty clay loam, 2 to 6 percent slopes	8,707	.6
Caputa loam, 6 to 9 percent slopes	1,551	.1	Razor silty clay loam, 6 to 9 percent slopes	643	(1)
Chinook fine sandy loam, 0 to 3 percent slopes	3,075	.2	Redig clay loam, 9 to 25 percent slopes	2,415	.2
Colby-Canyon silt loams, 6 to 25 percent slopes	3,571	.2	Riverwash	1,037	.1
Dix sandy loam, 0 to 3 percent slopes	664	(1)	Rock outcrop-Spearfish complex, 25 to 50 percent slopes	390	(1)
Epsie clay, 3 to 25 percent slopes	14,563	1.0	Saline-Alkali land	23,183	1.6
Epsie-Shale land complex, 9 to 45 percent slopes	23,632	1.7	Saline alluvial land	8,600	.6
Glenberg fine sandy loam, 0 to 2 percent slopes	9,086	.6	Satanta loam, 0 to 2 percent slopes	2,189	.2
Glenberg fine sandy loam, 2 to 6 percent slopes	545	(1)	Satanta loam, 2 to 6 percent slopes	4,067	.3
Glenberg and Haverson soils	7,524	.5	Satanta loam, 6 to 9 percent slopes	1,274	.1
Graner clay, 3 to 25 percent slopes	2,541	.2	Savo silty clay loam, 0 to 2 percent slopes	3,121	.2
Grummit clay, 3 to 25 percent slopes	11,006	.8	Savo silty clay loam, 2 to 6 percent slopes	636	(1)
Hanly loamy fine sand	3,013	.2	Schamber loam, 6 to 25 percent slopes	4,057	.3
Haverson loam, 0 to 2 percent slopes	6,860	.5	Shale land	22,378	1.6
Haverson loam, 2 to 6 percent slopes	460	(1)	Shale land-Grummit complex, 15 to 45 percent slopes	10,312	.7
Hisle loam, 0 to 9 percent slopes	7,019	.5	Slickspots-Demar complex, 0 to 6 percent slopes	4,711	.3
Hisle-Slickspots complex, 0 to 9 percent slopes	33,749	2.4	Slickspots-Wasa complex, 0 to 6 percent slopes	61,452	4.2
Keith silt loam, 0 to 2 percent slopes	4,815	.3	Snomo-Shale land complex, 3 to 25 percent slopes	12,143	.9
Keith silt loam, 2 to 6 percent slopes	3,068	.2	Sorum fine sandy loam, 0 to 6 percent slopes	13,943	1.0
Keith silt loam, 6 to 9 percent slopes	700	(1)	Stetter clay	26,659	1.9
Kyle clay, 0 to 2 percent slopes	11,759	.8	Stetter clay, channeled	9,955	.7
Kyle clay, 2 to 6 percent slopes	31,120	2.2	Stony steep land	10,275	.7
Kyle clay, 6 to 9 percent slopes	801	.1	Swanboy clay, 0 to 3 percent slopes	25,690	1.8
Kyle clay, terrace	18,473	1.3	Swanboy-Slickspots complex	19,483	1.4
Kyle-Pierre clays, 0 to 6 percent slopes	18,881	1.3	Terrace escarpments	2,681	.2
Lakoa-Colby association, 9 to 50 percent slopes	4,720	.3	Twilight fine sandy loam, 3 to 25 percent slopes	24,721	1.7

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Area	Extent
	Acres	*Percent*
Twilight-Assinniboine fine sandy loams, 3 to 9 percent slopes	28,724	2.0
Twilight-Blackhall fine sandy loams, 6 to 18 percent slopes	12,307	.9
Twotop clay, 0 to 9 percent slopes	32,840	2.3
Vale silt loam, 0 to 2 percent slopes	646	(1)
Wasa-Slickspots complex, 0 to 6 percent slopes	35,132	2.5
Whitelake fine sandy loam, 0 to 2 percent slopes	480	(1)
Winler clay, 0 to 9 percent slopes	192,596	13.3
Zeona loamy fine sand, 0 to 6 percent slopes	4,862	.3
Water areas less than 40 acres in size	6,190	.4
Total land area	1,439,680	100.0
Water areas more than 40 acres in size	10,560	
Total area in county	1,450,240	

[1] Less than 0.05 percent.

inches thick, is calcareous clay loam and sandy clay loam that is dark grayish brown in the upper part and grayish brown in the lower part. The upper part is extremely hard when dry and very firm when moist. The lower part contains spots and streaks of lime and salts. The underlying material is calcareous, multicolored sandy clay loam.

Absher soils have low fertility and moderate available water capacity. Permeability is very slow, and runoff is slow to rapid. The surface layer is susceptible to soil blowing unless protected by vegetation.

Almost all areas are in native vegetation and are used for range. The native vegetation is mainly short grasses, pricklypear cactus, and sagebrush.

Representative profile of Absher fine sandy loam in an area of Absher-Slickspots complex, 0 to 9 percent slopes, in native grass, 1,320 feet east and 280 feet north of the southwest corner of sec. 18, T. 12 N., R. 8 E.:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, fine, granular structure; loose, very friable; many roots; slightly acid; clear, smooth boundary.

A2—4 to 5 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, very fine, granular structure; loose, very friable; many roots; neutral; abrupt, wavy boundary.

B21t—5 to 9 inches, dark grayish-brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; strong, medium, columnar structure parting to strong, medium and fine, blocky; extremely hard, very firm; few roots; light-gray (5Y 7/1) coatings on column tops; moderately thick continuous clay films on vertical and horizontal faces of peds; few segregations of lime; slight effervescence; mildly alkaline; clear, wavy boundary.

B22t—9 to 15 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure parting to strong, medium and fine, blocky; extremely hard, very firm; few roots; moderately thick continuous clay films on vertical and horizontal faces of peds; few coarse segregations of lime; slight effervescence; moderately alkaline; clear, wavy boundary.

B31casa—15 to 18 inches, grayish-brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, prismatic structure parting to moderate, medium and coarse, blocky; very hard, friable; very few roots; thin continuous clay films on vertical and horizontal faces of peds; yellowish-brown (10YR 5/6) iron stains; many fine and medium segregations of lime and salt; slight effervescence; mildly alkaline; clear, wavy boundary.

B32casa—18 to 21 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few, prominent, yellowish-brown (10YR 5/6) mottles; weak, very coarse, prismatic structure parting to weak, subangular blocky; very hard, friable; thin continuous clay films on vertical and horizontal faces of peds; common medium segregations of lime and salt; slight effervescence; moderately alkaline; abrupt, smooth boundary.

C—21 to 60 inches, light brownish-gray (2.5Y 6/2), yellowish-brown (10YR 5/6), brownish-yellow (10YR 6/6), light-gray (2.5Y 7/2), and white (N 8/0) sandy clay loam, yellowish brown (10YR 5/6), grayish brown (2.5Y 5/2), dark grayish brown (2.5Y 4/2), and light gray (2.5Y 7/2) moist; massive; very hard, friable; strong effervescence; mildly alkaline.

The solum ranges from 13 to 24 inches in thickness. Depth to free carbonates ranges from 5 to 18 inches. The A horizon ranges from gray or grayish brown to light gray in hues of 10YR and 2.5Y and from fine sandy loam to silt loam. It is 2 to 5 inches thick. The B2t horizon ranges from dark grayish brown to pale olive in hue of 10YR, 2.5Y, or 5Y. It is clay loam or clay; the clay content ranges from 35 to 50 percent. The upper part of the B2t horizon has moderate or strong, fine to coarse, columnar and blocky structure. The lower part has medium or coarse prisms parting to moderate or strong, fine to coarse blocks. The C horizon ranges from sandy loam to clay. In places soft clayey to sandy shale, sandstone, or siltstone is at a depth of 40 to 60 inches.

Absher soils are mapped with Oburn soils and Slickspots and are near Assinniboine, Belfield, Ralph, and Twilight soils. They have a thinner A horizon than Belfield and Oburn soils and do not have the B&A horizon that is characteristic of Belfield soils. They have a B horizon that contains more clay and more sodium than that of Assinniboine, Ralph, and Twilight soils. They have distinct, columnar structure in the B horizon, which does not occur in Slickspots, and they have a lower concentration of salts within a depth of 10 inches.

Absher-Oburn complex, 0 to 3 percent slopes (AbA).—This mapping unit is about 60 percent Absher soils, 20 to 30 percent Oburn soils, and 10 to 20 percent other soils. It is on terraces along streams. Areas are irregular in shape and range from 10 to 100 acres in size. The Absher and Oburn soils are closely intermingled in an erratic pattern. They have profiles similar to the ones described as representative of their respective series, but in many areas the surface layer is loam or silt loam.

Included with these soils in mapping are areas of Assinniboine and Belfield soils and Slickspots. Assinniboine soils are on slight rises, and Belfield soils are in swales. Slickspots are in small, slightly depressed, low spots that have little or no vegetation.

Absher and Oburn soils initially take in water readily, but after the surface layer is saturated water penetrates the claypan subsoil very slowly.

Runoff is slow. These soils have low fertility. The Absher soil has poor tilth.

Most of the acreage is in native grass and is used for range. Absher soil in Thin Claypan range site, capability unit VIs-3, and windbreak group 10; Oburn soil in Claypan range site, capability unit IVs-2, and windbreak group 9.

Absher-Oburn complex, 3 to 9 percent slopes (AbB).—This mapping unit is about 60 percent Absher soils, 20 percent Oburn soils, and 20 percent other soils. It is on foot slopes and terraces and in drainage sags. Areas range from 15 to 100 acres in size. The Absher and Oburn soils are closely intermingled. They have profiles similar to the ones described as representative of their respective series, but in a few places depth to bedrock is less than 40 inches and in places the surface layer is loam.

Included with these soils in mapping are areas of Assinniboine, Belfield, Ralph, and Twilight soils and Slickspots. Assinniboine, Ralph, and Twilight soils are on the higher parts of the landscape. Belfield soils are in swales. Slickspots are in small slightly depressed spots that have little or no vegetation.

Absher and Oburn soils initially take in water readily, but after the surface layer is saturated water penetrates the claypan subsoil very slowly. Runoff is medium or rapid, depending on slope. These soils have low fertility. The Absher soil has poor tilth.

Most of the acreage is in native grass and is used for range. Capability unit VIs-3; windbreak group 10; Absher soil in Thin Claypan range site, Oburn soil in Claypan range site.

Absher-Slickspots complex, 0 to 9 percent slopes (AeB).—This mapping unit is about 40 percent Absher soils, 40 percent Slickspots, and 20 percent other soils. It is on terraces and foot slopes and in drainage sags on uplands. Areas range from 5 to 1,000 acres in size. Surface relief is made uneven by the many small depressions that are interspersed between slight rises or mounds. The Absher soil is on the slight rises. It has a profile similar to the one described as representative of the series, but depth to bedrock is less than 40 inches in some upland areas. Areas of Slickspots are in the small depressions. They commonly have visible salts within 10 inches of the surface and are nearly barren of vegetation.

Included with these soils in mapping are areas of Assinniboine, Belfield, Oburn, Ralph, and Twilight soils. Of these, Oburn soils are the most extensive and are intermingled with Absher soils on the slight rises. Assinniboine, Ralph, and Twilight soils are on the higher and more sloping parts of the landscape. Belfield soils are along drainageways.

Absher soils and Slickspots take in water very slowly, and their claypan subsoil releases moisture slowly to plants. Runoff ranges from slow on the nearly level soils to rapid on the sloping parts of the complex. Tilth is very poor. The areas are not suited to cultivation.

All the acreage is used for range. Absher soil in Thin Claypan range site, capability unit VIs–3, and windbreak group 10; Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group.

Alice Series

The Alice series consists of deep, gently sloping to sloping, well-drained loamy soils on terraces and uplands. These soils formed in sandy alluvium and wind-deposited sandy material.

In a representative profile the surface layer is grayish-brown fine sandy loam about 7 inches thick. The subsoil, about 13 inches thick, is brown and yellowish-brown fine sandy loam. It is slightly hard when dry and very friable when moist. The underlying material to a depth of 28 inches is brown fine sandy loam. Below this is calcareous, pale-brown fine sandy loam.

Alice soils have medium fertility and moderate or high available water capacity. Permeability is moderately rapid, and runoff is slow or medium. Soil blowing is a hazard.

These soils are used for crops and range. Alfalfa and small grain are the main crops. The native vegetation is mid, short, and tall grasses.

Representative profile of Alice fine sandy loam, 2 to 6 percent slopes, in crops, 2,110 feet north and 50 feet west of the southeast corner of sec. 14, T. 8 N., R. 4 E.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; cloddy; slightly hard, very friable; many roots; neutral; abrupt, smooth boundary.

B21—7 to 11 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, very coarse, prismatic structure; slightly hard, very friable; common roots; slightly acid; clear, smooth boundary.

B22—11 to 20 inches, yellowish-brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak, very coarse, prismatic structure; slightly hard, very friable; common roots; slightly acid; gradual, wavy boundary.

C1—20 to 28 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; few roots; slightly acid; clear, wavy boundary.

C2ca—28 to 60 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; violent effervescence; mildly alkaline.

Thickness of the solum and depth to free carbonates range from 18 to 38 inches. The A horizon ranges from dark grayish brown to grayish brown or brown. It commonly is fine sandy loam, but ranges from loamy fine sand to loam. The B2 horizon ranges from dark grayish brown to yellowish brown or light olive brown in hue of 10YR or 2.5Y. It ranges from sandy loam to loam and is less than 18 percent clay. The C horizon is fine sandy loam, sandy loam, and loamy fine sand.

Alice soils are near Altvan, Dix, Keith, Manter, Mawer, and Satanta soils. They do not have the distinct B2t horizon that is characteristic of Altvan, Keith, Manter, Mawer, and Satanta soils or the gravelly C horizon of Dix soils.

Alice fine sandy loam, 2 to 6 percent slopes (AfB).—This soil is on high terraces. Areas are irregular in shape and range from 10 to 500 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Dix, Manter, Mawer, and Satanta soils. Dix and Mawer soils are on rises underlain by gravel at a depth of less than 40 inches. Manter soils are inter-

mingled with Alice soils. Satanta soils are in the less sandy parts of the landscape.

This Alice soil takes in water readily and has moderate or high available water capacity. Runoff is slow. This soil is slightly susceptible to erosion and is susceptible to soil blowing.

Many areas are cultivated. Alfalfa is the main irrigated crop. Alfalfa and small grain are the main dryland crops. Control of soil blowing and erosion is the main concern in management. Sandy range site; capability units IIIe–4 irrigated and IVe–7 dryland; windbreak group 5.

Alice fine sandy loam, 6 to 9 percent slopes (AfC).—This soil is on uplands. Areas are irregular in shape and range from 5 to 100 acres in size. Included in mapping are small areas where slopes are less than 6 percent.

This soil takes in water readily and has moderate or high available water capacity. It has medium fertility. It is highly susceptible to erosion and soil blowing.

Most of the acreage is in native grass and is used for range. Control of soil blowing and erosion is the main concern in management. Sandy range site; capability unit VIe–7; windbreak group 10.

Altvan Series

The Altvan series consists of nearly level to gently sloping, well-drained loamy soils that are underlain by sand and gravel at a depth ranging from 20 to 40 inches. These soils formed in loamy alluvium and are on terraces along the Belle Fourche River.

In a representative profile the surface layer is brown loam about 7 inches thick. The subsoil is brown clay loam about 8 inches thick that is hard when dry and firm when moist. The underlying material to a depth of 22 inches is calcareous, light brownish-gray clay loam. Below this is a thin layer of calcareous, grayish-brown gravelly loam. Below a depth of 26 inches is stratified sand and gravel.

Altvan soils have medium fertility and low or moderate available water capacity. Permeability is moderate in the subsoil and rapid in the underlying sand and gravel. Runoff is slow or medium.

These soils are used mainly for irrigated crops. Alfalfa and corn are the main crops.

Representative profile of Altvan loam, 0 to 2 percent slopes, in crops, 2,475 feet north and 1,155 feet west of the southeast corner of sec. 4, T. 8 N., R. 5 E.:

Ap—0 to 7 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; cloddy parting to weak, fine, granular structure; slightly hard, friable; many roots; neutral; abrupt, smooth boundary.

B2t—7 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium and coarse, subangular blocky; hard, firm; many roots; thin continuous clay films on faces of peds; very few pebbles ranging from 2 millimeters to 1 inch in diameter; neutral; clear, smooth boundary.

C1ca—15 to 22 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm; few roots; common pebbles ranging from 1 to 5 millimeters in diameter; strong effervescence; mildly alkaline; clear, smooth boundary.

IIC2—22 to 26 inches, grayish-brown (2.5Y 5/2) gravelly loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, firm; gravel and cobblestones make up about 50 percent of total volume and range from 4 millimeters to 4 inches in diameter; strong effervescence; mildly alkaline; clear, smooth boundary.

IIC3—26 to 60 inches, sand and gravel; gravel makes up about 30 percent of total volume and ranges from 2 millimeters to 3 inches in diameter; single grained; loose; strong effervescence; mildly alkaline.

The solum ranges from 14 to 25 inches in thickness. Depth to free carbonates ranges from 13 to 22 inches, and depth to sand and gravel ranges from 20 to 40 inches. The A horizon ranges from dark grayish brown to brown and is 5 to 8 inches thick. The B2t horizon ranges from dark grayish brown to grayish brown or brown in hue of 10YR or 2.5Y. It is clay loam or loam and ranges from 24 to 35 percent clay.

Altvan soils are near Dix, Keith, Manter, Mawer, and Satanta soils. They are deeper over sand and gravel than Dix soils. They differ from Keith and Satanta soils in having sand and gravel at a depth of less than 40 inches. They contain less sand in the B horizon than Manter and Mawer soils.

Altvan loam, 0 to 2 percent slopes (AlA).—This soil is on high terraces mainly along the Belle Fourche River. Areas are irregular in shape and range from 10 to 800 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Dix, Keith, Mawer, and Satanta soils. Dix soils are in areas that are shallow over gravel. Keith and Satanta soils are in areas that are more than 40 inches deep over gravel. Mawer soils are in sandy areas.

This Altvan soil has medium fertility. It takes in water readily, but it is somewhat droughty because it contains sand and gravel at a moderate depth. Runoff is slow.

Many areas are in cultivation and are irrigated. Alfalfa and corn are the main irrigated crops. Under dryland conditions small grain crops are better suited than corn. Conservation of moisture is the main concern in management, but soil blowing is a slight hazard. Silty range site; capability units IIs–2 irrigated and IVs–1 dryland; windbreak group 6.

Altvan loam, 2 to 6 percent slopes (AlB).—This soil is on high terraces. Areas are irregular in shape and range from 5 to 60 acres in size.

Included with this soil in mapping are areas of Dix, Keith, and Satanta soils. Dix soils are near the crests of rises or on the shoulders of drainageways. Keith and Satanta soils are in areas where sand and gravel are at a depth of more than 40 inches.

This Altvan soil has low or moderate available water capacity and is somewhat droughty. Runoff is medium. The soil is subject to erosion and soil blowing.

Many areas are cultivated and are irrigated. Alfalfa and corn are the main irrigated crops. In dryland areas small grain crops are better suited than corn. Control of erosion and soil blowing is the main concern in management. Silty range site; capability units IIIes–1 irrigated and IVe–2 dryland; windbreak group 6.

Archin Series

The Archin series consists of deep, nearly level, well-drained loamy soils that have a claypan sub-

soil. These soils are on terraces. They formed in sandy alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 5 inches thick. The subsurface layer is light brownish-gray fine sandy loam about 5 inches thick. The subsoil is about 11 inches thick. It is grayish-brown sandy clay loam in the upper part, light brownish-gray sandy clay loam in the middle, and light brownish-gray fine sandy loam in the lower part. The upper part is very hard when dry and firm when moist. The middle and lower parts are calcareous. The underlying material is calcareous, light brownish-gray and grayish-brown fine sandy loam.

Archin soils have low fertility and moderate available water capacity. Permeability and runoff are very slow. Soil blowing is a hazard.

These soils are used mainly for range. The native vegetation is mainly mid and short grasses, pricklypear cactus, and sagebrush.

Representative profile of Archin fine sandy loam in an area of Archin-Slickspots complex, 0 to 3 percent slopes, in native grass, 2,375 feet north and 300 feet west of the southeast corner of sec. 15, T. 14 N., R. 6 E.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, very fine, granular structure; soft, very friable; many roots; medium acid; gradual, wavy boundary.

A2—5 to 10 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, coarse, subangular blocky structure; slightly hard, very friable; many roots; neutral; abrupt, smooth boundary.

B21t—10 to 14 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; strong, medium and coarse, columnar structure parting to strong, medium, blocky; very hard, firm; few roots; light brownish-gray coatings on column tops; thin continuous clay films; moderately alkaline; clear, smooth boundary.

B22tca—14 to 17 inches, light brownish-gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, blocky; very hard, friable; few roots; thin patchy clay films; common medium segregations of lime; strong effervescence; moderately alkaline; gradual boundary.

B3ca—17 to 21 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak, medium and coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; common fine and medium segregations of lime; strong effervescence; moderately alkaline; gradual boundary.

C1ca—21 to 36 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure; hard, friable; common fine and medium segregations of lime; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2ca—36 to 60 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; very weak, coarse, prismatic structure; hard, very friable; common medium segregations of lime; slight effervescence; moderately alkaline.

Depth to lime ranges from 12 to 18 inches. The A horizon has hue of 10YR or 2.5Y. It is fine sandy loam or sandy loam and has a combined thickness of 7 to 12 inches. The B2t horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is sandy clay loam or clay loam that is 18 to 27 percent clay and more than 15 percent material coarser than very fine sand. The B21t horizon has moderate or strong structure. The B2t horizon ranges from 6 to 10 inches in thickness. The C horizon commonly is fine sandy loam or sandy loam, but in places it is stratified with clay loam or clay at a depth of more than 30 inches.

Archin soils are mapped with Slickspots and are near Chinook and Sorum soils. They differ from Slickspots in having distinct, columnar structure in the B horizon and in having less salts at shallow depths. They contain more clay and sodium in the B horizon than Chinook soils. They have a thinner A horizon than Sorum soils.

Archin-Slickspots complex, 0 to 3 percent slopes (AnA).—This mapping unit is about 60 percent Archin soils, 30 percent Slickspots, and 10 percent other soils. It is on terraces. Areas range from 10 to 500 acres in size and have an uneven surface. Archin soils are on many small mounds or ridges that rise 6 to 15 inches above the intervening low spots of Slickspots in small depressions. The depressions range from 5 to 50 feet in diameter. Areas of Slickspots commonly are nearly barren of vegetation.

Included with these soils in mapping are areas of Assinniboine, Chinook, and Sorum soils. Assinniboine and Chinook soils are on some of the larger mounds. Sorum soils are intermingled with Archin soils.

Archin soils take in water readily until the surface layer is saturated, but water penetrates the claypan subsoil very slowly. Runoff is very slow and commonly ponds in the small depressions of Slickspots. Archin soils are susceptible to soil blowing.

Most of the acreage is in native grass and is used for range. Archin soils are suited to cultivation, but in most areas they are so intermingled with Slickspots that cultivation is not feasible. Archin soil in Claypan range site, capability unit IVs–2, and windbreak group 9; Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group.

Arvada Series

The Arvada series consists of deep, nearly level, well-drained silty soils that have a claypan subsoil. These soils are on terraces and fans. They formed in clayey alluvium derived from shale.

In a representative profile the surface layer is light brownish-gray silt loam about 2 inches thick. The subsoil, about 25 inches thick, is dark grayish-brown and grayish-brown silty clay in the upper part and calcareous, gray silty clay loam in the lower part. The upper part is extremely hard when dry and very firm when moist. The lower part contains many spots and streaks of lime and salts. The underlying material is calcareous, grayish-brown silty clay loam.

Arvada soils have low natural fertility and moderate available water capacity. Permeability is very slow, and runoff is slow or medium.

Most of the acreage is used for range. The native vegetation is mainly short grasses, pricklypear cactus, sagebrush, and greasewood.

Representative profile of Arvada silt loam in an area of Arvada-Slickspots complex, 0 to 3 percent slopes, in native grass, near the southeast corner of sec. 15, T. 10 N., R. 2 E.:

A2—0 to 2 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak, thin,

platy structure parting to weak, very fine, granular; loose, friable; common roots; slightly acid; abrupt, smooth boundary.

B21t—2 to 8 inches, dark grayish-brown (2.5Y 4/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate, coarse and very coarse, columnar structure parting to moderate, coarse and medium, blocky; light brownish-gray silt coatings on column tops; extremely hard, very firm; few roots; thin continuous clay films on vertical and horizontal faces of peds; neutral; gradual, wavy boundary.

B22t—8 to 13 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, prismatic structure parting to moderate, medium and fine, blocky; extremely hard, very firm; few roots; thin patchy clay films on vertical and horizontal faces of peds; strong effervescence; moderately alkaline; gradual, wavy boundary.

B3casa—13 to 27 inches, gray (5Y 5/1) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and coarse, subangular blocky structure; very hard, very firm; very few roots; thin patchy clay films; many segregations of salts and lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C—27 to 60 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm; strong effervescence; mildly alkaline.

The solum ranges from 15 to 30 inches in thickness. Depth to free carbonates ranges from 0 to 15 inches, but is ordinarily less than 10 inches. The A horizon ranges from gray to light gray in hues of 10YR to 5Y. It commonly is silt loam, but ranges from very fine sandy loam to silty clay loam or clay loam. It is 2 to 5 inches thick. The B horizon ranges from dark grayish brown or olive to light brownish gray or pale olive in hues of 10YR to 5Y. The B2t horizon is silty clay loam to clay and is 35 to 60 percent clay. The B21t horizon has weak or moderate, coarse or very coarse, columnar structure parting to moderate or strong, blocky. The B3 horizon contains common to many segregations of salts and lime. The C horizon ranges from silt loam to clay and commonly is stratified.

Arvada soils are mapped with Slickspots and resemble Hisle soils. In contrast with Slickspots, they have distinct, columnar structure in the B horizon and a smaller amount of salts within 10 inches of the surface. They are deeper over bedded shale than Hisle soils.

Arvada silt loam, 0 to 3 percent slopes (ArA).—This soil is on broad terraces along some of the main creeks. Areas range from 10 to 300 acres in size.

Included with this soil in mapping are areas of Stetter soils and Slickspots. Stetter soils are on narrow bottoms along stream channels, and Slickspots are in small depressions or low spots. Also included in some areas are soils that have a claypan and a thicker surface layer than Arvada soils and saline soils that have salts at or near the surface.

This Arvada soil takes in water very slowly and releases it slowly to plants. It has poor tilth and is not suitable for cultivation.

Most of the acreage is in native vegetation and is used for range. Greasewood and sagebrush are a prominent part of the vegetation in some areas. Thin Claypan range site; capability unit VIs–3; windbreak group 10.

Arvada-Slickspots complex, 0 to 3 percent slopes (AsA).—This mapping unit is about 60 percent Arvada soils and 20 to 40 percent Slickspots. It is on terraces along some of the major creeks and drainageways. Relief is uneven because many mounds rise 4 to 8 inches above small depressions. The Arvada soil is on the mounds. It has the profile described as representative of the Arvada series. Areas of Slickspots are in small depressions 10 to 100 feet wide.

Included with these soils in mapping are areas of Stetter soils along drainageways, claypan soils that have a thicker surface layer than Arvada soil, and saline soils that have salts at or near the surface.

These soils take in water slowly and release it slowly to plants. They have very poor tilth and are not suitable for cultivation. Runoff is slow and commonly ponds in the depressions until it evaporates.

Areas of this mapping unit are used for range. Sagebrush and greasewood are a prominent part of the vegetation in many areas. Most areas of Slickspots are nearly barren of vegetation. Arvada soil in Thin Claypan range site, capability unit VIs–3, and windbreak group 10; Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group.

Assinniboine Series

The Assinniboine series consists of deep, nearly level to gently undulating, well-drained loamy soils. These soils are on terraces, fans, and uplands. They formed in sandy alluvium or in eolian deposits.

In a representative profile the surface layer is grayish-brown fine sandy loam about 6 inches thick. The subsoil is about 27 inches thick. It is brown sandy clay loam in the upper part, grayish-brown sandy clay loam in the middle, and grayish-brown fine sandy loam in the lower part. The upper part is hard when dry and friable when moist. The underlying material is calcareous, light brownish-gray fine sandy loam.

Assinniboine soils have medium fertility and moderate or high available water capacity. Permeability is moderate, and runoff is slow. Soil blowing is a hazard.

Most areas are in native vegetation and are used mainly for range. Small grain and alfalfa are the main crops in cultivated areas. The native vegetation is mid and short grasses.

Representative profile of Assinniboine fine sandy loam, 0 to 3 percent slopes, formerly cultivated and now in grass, 2,110 feet west and 60 feet south of the northeast corner of sec. 10, T. 14 N., R. 5 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine and medium, granular structure; slightly hard, very friable; many roots; neutral; abrupt, smooth boundary.

B21t—6 to 15 inches, brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; dark grayish-brown (10YR 4/2) coatings on peds, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to moderate, coarse and medium, blocky; hard, friable; common roots; thin continuous clay films; neutral; gradual, smooth boundary.

B22t—15 to 22 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse and medium, prismatic structure parting to moderate, medium and coarse, blocky; hard, friable; common roots; thin continuous clay films; neutral; gradual, wavy boundary.

B3—22 to 33 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; slightly hard, very friable; few roots; thin patchy clay films; neutral; gradual, wavy boundary.

C—33 to 60 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; few segregations of lime; strong effervescence; mildly alkaline.

The solum ranges from 11 to 37 inches in thickness. Depth to carbonates ranges from 15 to 35 inches. The A horizon ranges from dark grayish brown to grayish brown or brown. It commonly is fine sandy loam, but ranges from loamy fine sand to loam. It ranges from 3 to 9 inches thick. The B2t horizon ranges from dark grayish brown to light yellowish brown in hue of 10YR or 2.5Y. It is sandy clay loam or loam that is 18 to 27 percent clay. The B2t horizon has weak or moderate, medium to very coarse, prismatic structure parting to moderate or strong, medium or coarse, blocky. The B2t horizon ranges from 5 to 17 inches in thickness. The C horizon commonly is stratified and ranges from fine sand to clay loam.

Assinniboine soils are mapped with Twilight soils and are near Absher, Blackhall, Oburn, Ralph, and Sorum soils. They contain less sodium than Absher, Oburn, and Sorum soils and do not have the columnar structure in the B horizon that is characteristic of those soils. They are deeper over sandstone or other bedrock than Blackhall and Twilight soils. They differ from Parshall soils in having thinner horizons that are very dark grayish brown or darker when moist. They contain more sand and are less silty than Ralph soils.

Assinniboine fine sandy loam, 0 to 3 percent slopes (AtA).—This soil is on terraces and uplands. Areas are irregular in shape and are mainly less than 50 acres in size.

Included with this soil in mapping are areas of Chinook and Sorum soils. Chinook soils are on some of the slight rises. Sorum soils are in slightly depressed flat parts of the areas. Included soils make up less than 15 percent of any given area.

This Assinniboine soil takes in water readily and has moderate or high available water capacity. It has medium fertility. It is susceptible to soil blowing.

Most of the acreage is used for range. A few areas are cultivated. Alfalfa and small grain are the main crops. Control of soil blowing is the main concern in management. Sandy range site; capability unit IVe–6; windbreak group 5.

Baca Series

The Baca series consists of deep, nearly level to gently sloping, well-drained silty soils. These soils are on fans and terraces. They formed in clayey alluvium.

In a representative profile the surface layer is grayish-brown silty clay loam about 2 inches thick. The subsoil, about 25 inches thick, is silty clay loam that is brown in the upper part and grayish brown in the lower part. It is hard or very hard when dry and firm when moist. Below a depth of 8 inches it is calcareous, and below a depth of 18 inches it contains many spots and streaks of lime that extend into the underlying material. The underlying material is calcareous, grayish-brown silty clay loam.

Baca soils have low fertility and moderate or high available water capacity. Permeability is slow, and runoff is slow or medium.

Most areas are in native vegetation and are used mainly for range. Other areas are cultivated, either as dryland or under irrigation. Alfalfa and small grain are the main crops. The native vegetation is mid and short grasses, sedges, and pricklypear cactus.

Representative profile of Baca silty clay loam, 2 to 6 percent slopes, in native grass, 1,430 feet west and 1,900 feet south of the northeast corner of sec. 1, T. 9 N., R. 2 E.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, thin, platy structure parting to weak, very fine, granular; slightly hard, very friable; many roots; neutral; clear, smooth boundary.

B21t—2 to 8 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) crushing to dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, firm, sticky and plastic; many roots; thin continuous clay films; neutral; clear, wavy boundary.

B22t—8 to 18 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm, sticky and plastic; common roots; thin patchy clay films; strong effervescence; moderately alkaline; clear, wavy boundary.

B3ca—18 to 27 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm, sticky and plastic; common roots; many fine and medium segregations of lime; strong effervescence; moderately alkaline; clear, wavy boundary.

C1ca—27 to 40 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and coarse, subangular blocky structure; very hard, firm, sticky and plastic; few roots; many coarse segregations of lime; strong effervescence; moderately alkaline; diffuse, wavy boundary.

C2—40 to 60 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; strong effervescence; moderately alkaline.

The solum ranges from about 17 to 35 inches in thickness. Depth to carbonates commonly ranges from 5 to 12 inches, but in some cultivated areas the soil is calcareous at or near the surface. The upper 10 inches of the solum is more than 0.58 percent organic carbon. The A horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is silty clay loam or silt loam and ranges from 2 to 5 inches thick. The B2t horizon has the same range of colors as the A horizon. It is silty clay loam or silty clay that is 35 to 50 percent clay and less than 15 percent coarser than fine sand. It has weak or moderate, prismatic structure. The B2t horizon is neutral or mildly alkaline in the upper part and mildly alkaline or moderately alkaline in the lower part. The B3ca and C horizons range from grayish brown to pale yellow. They have common or many segregations of lime. In places they have segregations of gypsum and salt. The B3ca and C horizons are mildly alkaline or moderately alkaline. In places calcareous soft shale is at depths between 40 and 60 inches.

Baca soils are near Midway and Razor soils and are similar to Kyle and Manvel soils. They are deeper over calcareous shale than Midway and Razor soils. They are less clayey and contain more carbonates than Kyle soils. They are more clayey and contain less carbonates than Manvel soils.

Baca silty clay loam, 0 to 2 percent slopes (BaA).—This soil is on terraces and upland fans. Areas are irregular in shape and range from 10 to 300 acres in size. This soil has a profile similar to the one described as representative of the series, but in places the surface layer is slightly thicker. Some cultivated areas are slightly eroded, and the surface layer is calcareous. Included in mapping are areas of Razor soils on slight rises.

This soil takes in water slowly, but has moderate or high available water capacity. Runoff is slow. In

Figure 8.—Badland.

cultivated areas tilth deteriorates and the soil is subject to blowing.

Many areas are cultivated, and some are under irrigation. Alfalfa, corn, and small grain are the main irrigated crops. Winter wheat and alfalfa are the main dryland crops. Maintenance of tilth and improvement of water intake are the main concerns in management. Clayey range site; capability units IIs–1 irrigated and IIIs–1 dryland; windbreak group 4.

Baca silty clay loam, 2 to 6 percent slopes (BaB).—This soil is on terraces and fans. Areas are irregular in shape and range from 10 to 300 acres in size. This soil has a profile similar to the one described as representative of the series, but in some cultivated areas the surface layer has been mixed by plowing and is calcareous. Included in mapping are Razor soils on the higher parts of the landscape.

This soil takes in water slowly and loses its tilth easily in cultivated areas. Runoff is medium, and the soil is subject to erosion.

Many areas are in native grass and are used for range. Other areas are cultivated. Alfalfa, corn, and small grain are the main irrigated crops. Winter wheat and alfalfa are the main dryland crops. Control of erosion is the main concern in management. Clayey range site; capability units IIIe–1 irrigated and IVe–3 dryland; windbreak group 4.

Badland

Badland (0 to 50 percent slopes) (Bd) consists of bare, eroding exposures of soft bedrock on steep-sided buttes and in entrenched drainageways (fig. 8). The exposed bedrock makes up about 75 percent of any given area and supports little or no vegetation. Interspersed throughout most areas are small, nearly level to gently sloping mesas that are vegetated. Some of the less steep side slopes also are vegetated.

Included with this land in mapping are areas of Assiniboine, Blackhall, Cabbart, Ralph, Sorum, Twilight, and Zeona soils on the mesas and vegetated side slopes and areas of Hanly soils and Loamy alluvial land along drainageways.

Runoff is rapid, and geologic erosion is active. The vegetated areas are small and in places are inaccessible to livestock. Badland is poorly suited to range, but it has some value for wildlife habitat. Capability unit VIIIs–2; not assigned to a range site or windbreak group.

Barnum Series

The Barnum series consists of deep, nearly level, well-drained, calcareous silty soils. These soils are on bottom land and low terraces along the Redwater River. They formed in loamy alluvium.

In a representative profile the surface layer is pinkish-gray silt loam about 5 inches thick. The underlying material is brown and light-brown very fine sandy loam. Below a depth of 42 inches it contains many spots and streaks of soft lime.

Barnum soils have low natural fertility and high available water capacity. Permeability is moderate, and runoff is slow. Areas are subject to flooding in some years. Soil blowing is a hazard.

These soils are used for crops, range, hay, and wildlife habitat. Alfalfa, corn, and small grain are the main crops. The native vegetation is tall and mid grasses and stringers of native trees and shrubs along the stream channel in some areas.

Representative profile of Barnum silt loam in native grass, 1,320 feet west and 1,400 feet north of the southeast corner of sec. 2, T. 7 N., R. 2 E.:

A11—0 to 2 inches, pinkish-gray (7.5YR 6/3) silt loam, dark brown (7.5YR 4/3) moist; moderate, thick, platy structure; very hard, friable; many roots; very slight effervescence; neutral; abrupt, smooth boundary.

A12—2 to 5 inches, pinkish-gray (7.5YR 6/3) silt loam, dark brown (7.5YR 4/3) moist; weak, coarse and medium, subangular blocky structure; slightly hard, friable; many roots; very slight effervescence; neutral; clear, smooth boundary.

C1—5 to 15 inches, brown (7.5YR 5/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine, medium and coarse, subangular blocky structure; slightly hard, friable; common roots; strong effervescence; neutral; clear, wavy boundary.

C2—15 to 42 inches, light-brown (7.5YR 6/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; few roots; strong effervescence; mildly alkaline; clear, smooth boundary.

C3—42 to 60 inches, light-brown (7.5YR 6/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; many fine and medium segregations of lime; strong effervescence; mildly alkaline.

The profile typically is calcareous to the surface, but in places the upper few inches are leached. The A horizon ranges from grayish brown to light reddish brown in hues of 10YR to 5YR. It is silt loam, very fine sandy loam, or loam. The C horizon ranges from brown to pale red in hues of 2.5YR to 7.5YR. The weighted average texture of the C horizon is very fine sandy loam, loam, or silt loam that is 18 to 30 percent clay and more than 15 percent coarser than very fine sand. Buried A horizons are in the C horizon in some places.

Barnum soils are near Nevee, Spearfish, and Vale soils and are in positions similar to those of Glenberg and Haverson soils. They have more reddish colors than Glenberg and Haverson soils and contain more clay than Glenberg soils. They formed in more stratified material and have a more erratic distribution of organic matter than Nevee soils. They are deeper over soft bedrock than Spearfish soils. They do not have the B2t horizon that is characteristic of Vale soils.

Barnum silt loam (0 to 3 percent slopes) (Be).—This soil is on bottom land and low terraces along Redwater River. Areas are irregular in shape and range from 10 to 200 acres in size. This soil has the profile described as representative of the series.

This soil has low fertility. It takes in water readily and has a high available water capacity. Runoff is slow. Most areas are rarely flooded. This soil is subject to soil blowing.

Many areas are cultivated and commonly are irrigated. Corn, alfalfa, and small grain are the main crops. Improvement of fertility and water management is the main concern in irrigated areas. Conservation of moisture is the main concern in dryland areas. Silty range site; capability units I–3 irrigated and IIIc–2 dryland; windbreak group 1.

Barnum silt loam, channeled (0 to 3 percent slopes) (Bh).—This soil is on bottom land along Redwater River. Areas adjacent to the stream channel are long and narrow. Surface relief in many areas is made uneven by flood channels and meander scars. Included in mapping are gravelly soils immediately adjacent to the stream channel.

This soil is subject to flooding. Many areas also collect irrigation waste water from adjacent soils. Wetness and the narrow irregular shape of the areas make cultivation impractical.

This soil is better suited to grazing and wildlife habitat than to other uses. The native vegetation consists of tall and mid grasses and stringers of native trees and shrubs along the stream channel. Overflow range site; capability unit VIw–3; windbreak group 10.

Belfield Series

The Belfield series consists of deep, nearly level to gently sloping, well-drained silty soils. These soils are on terraces and fans and in upland swales. They formed in alluvium weathered from sandstone, siltstone, and shale.

In a representative profile the surface layer is grayish-brown silt loam about 8 inches thick. The subsurface layer is grayish-brown and light brownish-gray heavy silt loam about 6 inches thick. The subsoil is about 30 inches thick. It is light olive-brown silty clay loam in the upper part, grayish-brown clay loam in the middle, and calcareous, light brownish-gray clay loam in the lower part. The upper part is extremely hard when dry and firm when moist. The lower part contains many spots and streaks of lime. The underlying material is calcareous, gray clay loam.

Belfield soils have medium fertility and high available water capacity. Permeability is moderately slow, and runoff is slow or medium.

Most areas are in native vegetation and are used mainly for range. A few areas are cultivated. Alfalfa and small grain are the main crops. The native vegetation is mainly mid and short grasses.

Representative profile of Belfield silt loam in an area of Belfield-Oburn silt loams, 3 to 6 percent slopes, in native grass, 75 feet north and 1,200 feet west of the southeast corner of sec. 14, T. 12 N., R. 7 E.:

A11—0 to 3 inches, grayish-brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; weak, fine, granular structure; soft, friable; many roots; medium acid; clear, smooth boundary.

A12—3 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, thick, platy structure parting to moderate, medium, subangular blocky; hard, friable; many roots; medium acid; clear, wavy boundary.

B&A—8 to 14 inches, grayish-brown (2.5Y 5/2) heavy silt loam (B), very dark grayish brown (2.5Y 3/2) moist, and light brownish-gray (2.5Y 6/2) coatings of silt (A), dark grayish brown (2.5Y 4/2) moist; moderate, medium and fine, subangular blocky structure; hard, friable; common roots; neutral; clear, wavy boundary.

B21t—14 to 19 inches, light olive-brown (2.5Y 5/4) silty clay loam, dark grayish brown (2.5Y 4/3) moist; peds in upper part coated with light brownish gray (2.5Y 6/2), dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure parting to strong, medium and coarse, blocky; extremely hard, firm, plastic and sticky; few roots; thin continuous clay films; neutral; gradual, wavy boundary.

B22t—19 to 24 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, blocky; extremely hard, firm, sticky and plastic; few roots; thin continuous clay films; moderately alkaline; gradual, wavy boundary.

B3ca—24 to 44 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm, sticky and plastic; very few roots; thin patchy clay films; many medium and coarse segregations of lime; violent effervescence; moderately alkaline; gradual, wavy boundary.

C—44 to 60 inches, gray (2.5Y 6/1) clay loam, gray (2.5Y 5/1) moist; massive; very hard, firm, sticky and plastic; few fine segregations of lime; strong effervescence; moderately alkaline.

The solum ranges from 30 to 45 inches in thickness. Depth to free carbonates ranges from 18 to 26 inches. The A horizon ranges from dark gray to brown. It commonly is silt loam or loam, but ranges from very fine sandy loam to clay loam or silty clay loam. The A horizon ranges from 3 to 10 inches in thickness. The B&A or A&B horizon ranges from 1 to 6 inches in thickness. The B2t horizon ranges from dark grayish brown to light yellowish brown in hue of 10YR or 2.5Y. It is silty clay loam, clay loam, or clay and is 35 to 50 percent clay. The B2t horizon has weak or moderate, prismatic structure parting to moderate or strong, fine to coarse, blocky. The C horizon commonly is stratified and ranges from fine sandy loam to clay. Buried A horizons are in some places.

Belfield soils are mapped with Oburn soils and are near Absher, Assinniboine, Ralph, and Twilight soils. They differ from Absher and Oburn soils in not having columnar structure in the B2t horizon. They have a more clayey B horizon than Assinniboine, Ralph, and Twilight soils.

Belfield-Oburn silt loams, 0 to 3 percent slopes (BlA).—This mapping unit is about 60 percent Belfield soils, 30 percent Oburn soils, and 10 percent other soils. It is on fans and in swales. Areas are irregularly shaped and range from 10 to 400 acres in size. These soils are closely intermingled. They have profiles similar to the ones described as representative of their respective series, but the surface layer of the Oburn soil is silt loam.

Included with these soils in mapping are areas of Absher soils in small depressions.

Moisture penetrates the subsoils of these soils slowly, especially of the Oburn soil. Root systems are restricted by the clayey subsoil, and crops suffer periodically from lack of moisture.

Many areas are in native grass and are used for range. Alfalfa and small grain are the main crops in cultivated areas. Improvement of water intake and conservation of moisture are the main concerns in management. Capability unit IIIs–2; Belfield soil in Clayey range site, windbreak group 4; Oburn soil in Claypan range site, windbreak group 9.

Belfield-Oburn silt loams, 3 to 6 percent slopes (BlB).—This mapping unit is about 60 percent Belfield soils, 30 percent Oburn soils, and 10 percent other soils. It is on fans and in swales on uplands. Areas are irregularly shaped and range from 10 to 500 acres in size. The two soils are closely intermingled in an erratic pattern. The Belfield soil has the profile described as representative of the Belfield series. The Oburn soil has a profile similar to the one described as representative of the Oburn series, but the surface layer is silt loam.

Included with these soils in mapping are areas of Absher soils in slight depressions.

The clayey subsoils of Belfield and Oburn soils restrict the penetration of moisture and the development of plant roots. Runoff is medium, and the soils are subject to erosion.

Most areas are in native grass and are used for range. Alfalfa and small grain are the main crops in the few cultivated areas. Control of erosion and soil blowing is the main concern in management. Belfield soil in Clayey range site, capability unit IVe–9, and windbreak group 4; Oburn soil in Claypan range site, capability unit VIs–5, and windbreak group 10.

Bidman Series

The Bidman series consists of deep, nearly level to sloping, well-drained loamy soils on upland terraces and drainage divides. These soils formed in clayey alluvium of mixed origin.

In a representative profile the surface layer is light brownish-gray loam about 5 inches thick. The subsoil, about 23 inches thick, is grayish-brown clay. It is very hard when dry and very firm when moist. Below a depth of 14 inches it is calcareous. The underlying material to a depth of 53 inches is calcareous, grayish-brown clay loam and loam. Between depths of 42 and 53 inches it contains many spots of soft lime. Below a depth of 53 inches is calcareous, brown gravelly loamy sand.

Bidman soils have low fertility and moderate or high available water capacity. Permeability is slow, and runoff is slow or medium.

Most areas are in native vegetation and are used for range. Small grain and alfalfa are the main crops in the few cultivated areas. The native vegetation is mainly mid and short grasses, sagebrush, and pricklypear cactus.

Representative profile of Bidman loam, 3 to 6 percent slopes, in native grass, 300 feet east and 2,390 feet south of the northwest corner of sec. 32, T. 14 N., R. 5 E.:

A2—0 to 5 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, friable; many roots; few pebbles as much as 1 inch in diameter on surface and few pebbles less than one-fourth inch in diameter in matrix; neutral; clear, smooth boundary.

B21t—5 to 14 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate, medium and coarse, columnar structure parting to strong, medium and coarse, blocky; very hard, very firm; common roots; thin, continuous, very dark grayish-brown (2.5Y 3/2) clay films on faces of peds; few small pebbles in matrix; moderately alkaline; clear, smooth boundary.

B22t—14 to 18 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, blocky; very hard, very firm; common roots; thin continuous clay films on faces of peds; few small pebbles in matrix; few fine and medium segregations of lime; slight effervescence; mildly alkaline; clear, smooth boundary.

B3ca—18 to 28 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium and coarse, blocky structure; very hard, very firm; few roots; thin patchy clay films; few small pebbles in matrix; common coarse and medium segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C1—28 to 42 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, blocky structure; very hard, firm; few fine and medium segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C2ca—42 to 53 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; many coarse and medium segregations of lime; strong effervescence; mildly alkaline; abrupt boundary.

IIC3—53 to 60 inches, brown (10YR 5/3) gravelly loamy sand, brown (10YR 4/3) moist; single grained; loose; gravel is multicolored; strong effervescence; mildly alkaline.

The solum ranges from 20 to 36 inches in thickness. Pebbles as much as 1 inch in diameter commonly are scattered on the surface and throughout the profile. Depth to carbonates ranges from 8 to 18 inches. The A2 horizon ranges from grayish-brown to light-gray loam or light clay loam. The B2t horizon ranges from grayish-brown to pale-brown clay loam or clay that is 35 to 50 percent clay. In some places the columnar structure is poorly defined or is prismatic instead of columnar. The B3ca horizon ranges from sandy clay loam to clay. It has common or many, fine to coarse segregations of lime. The C horizon to a depth of 40 inches or more ranges from loam to clay.

Bidman soils are mapped with Redig soils and are near Kyle and Pierre soils. They formed in material similar to that in which Caputa soils formed. They have a lighter colored, thinner A horizon than Caputa soils. They have stronger structure in the B horizon and are less clayey than Kyle and Pierre soils. They do not have the high gypsum content that is characteristic of Redig soils.

Bidman loam, 0 to 3 percent slopes (BmA).—This soil is on high terraces and terrace remnants on uplands. Areas are irregular in shape and range from 5 to 200 acres in size.

Included with this soil in mapping are areas of Redig soils near the crests of slight rises. Also included are some areas where slopes are 3 percent or more. Included soils make up less than 15 percent of any given area.

This Bidman soil takes in water slowly and releases moisture slowly to plants. Fertility is low, and tilth deteriorates in cultivated areas.

Most of the acreage is in native grass and is used for range. Alfalfa and small grain are the main crops in the few cultivated areas. Improvement of water intake, fertility, and tilth is the main concern in management. Clayey range site; capability unit IIIs–2; windbreak group 4.

Bidman loam, 3 to 6 percent slopes (BmB).—This soil is on high terraces and terrace remnants on uplands. Areas are irregular in shape and range from 10 to 300 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Redig soils on the higher and steeper parts of the landscape and on isolated knobs. Also included are small areas where the Bidman soil has slopes of less than 3 percent and small areas where slopes are 6 percent or more. Included soils make up less than 20 percent of any given area.

This Bidman soil takes in water slowly. Runoff is medium. The soil is subject to erosion.

Most of the acreage is in native grass and is used for grazing. Small grain and alfalfa are the main crops in the few cultivated areas. Control of erosion is the main concern in management. Clayey range site; capability unit IVe–9; windbreak group 4.

Bidman-Redig complex, 2 to 9 percent slopes (BrB).—This mapping unit is about 60 percent Bidman soils, 30 percent Redig soils, and 10 percent other soils. It is on high terraces and terrace remnants on uplands. Areas are irregularly shaped and range from 10 to 500 acres in size. Slopes of the Bidman soil are long and smooth. The Bidman soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner in the more sloping parts of the complex. The Redig soil commonly is on the more sloping knolls where slopes are short.

Included with these soils in mapping are areas of Lismas, Pierre, and Schamber soils. Lismas and Pierre soils are in places where the underlying shale is close to the surface. Schamber soils are on gravelly knobs.

Bidman and Redig soils have low fertility. Runoff is medium. The soils are susceptible to erosion.

Most of the acreage is in native grass and is used for range. The Redig soil is not suitable for cultivation. Control of erosion is the main concern in management. Bidman soil in Clayey range site, capability unit IVe–9, and windbreak group 4; Redig soil in Thin Upland range site, capability unit VIe–3, and windbreak group 10.

Blackhall Series

The Blackhall series consists of shallow, sloping to moderately steep, well-drained, calcareous loamy soils on uplands. These soils formed in sandy material weathered from the underlying soft sandstone.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 2 inches thick. The underlying material to a depth of 8 inches is light brownish-gray fine sandy loam. It is soft when dry and very friable when moist. Below this is gray and light-gray, soft sandstone that is mainly noncalcareous, but is calcareous in spots.

Blackhall soils have low fertility and very low available water capacity. Permeability is moderately rapid, and runoff is medium.

All the areas are in native vegetation and are used for range. The native vegetation is mainly mid and short grasses.

Blackhall soils in Butte County are mapped only with Twilight soils.

Representative profile of Blackhall fine sandy loam in an area of Twilight-Blackhall fine sandy loams, 6 to 18 percent slopes, in native grass, 1,400 feet west and 1,900 feet south of the northeast corner of sec. 15, T. 13 N., R. 9 E.:

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; loose, very friable; many roots; strong effervescence; mildly alkaline; clear, smooth boundary.

C1—2 to 8 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; very weak, fine, granular structure; soft, very friable; many roots; strong effervescence; mildly alkaline; clear, smooth boundary.

C2—8 to 28 inches, gray (5Y 6/1) sandstone, olive gray (5Y 4/2) moist; massive parting to single grained; soft, very friable; common roots in upper part and few in lower part; matrix is noncalcareous, but calcareous spots are common; mildly alkaline; clear, wavy boundary.

C3—28 to 40 inches, light-gray (5Y 7/1) sandstone, gray (5Y 5/1) moist; massive parting to single grained; soft, very friable; matrix is noncalcareous, but calcareous spots are common; mildly alkaline.

Depth to bedrock ranges from 8 to 20 inches. In places the upper 1 inch to 3 inches of the soil is noncalcareous. The A horizon ranges from dark grayish brown to pale brown in hue of 10YR or 2.5Y. It is fine sandy loam or sandy loam and commonly is less than 4 inches thick. The C1 horizon ranges from grayish brown to pale yellow in hue of 10YR or 2.5Y and is fine sandy loam or sandy loam. The underlying beds of soft sandstone and sandy shale range from gray to pale yellow in hues of 10YR to 5Y. In some areas they are calcareous, and in others the bedrock is noncalcareous.

Blackhall soils are mapped with Twilight soils and are near Assinniboine, Cabbart, and Scroggin soils. They are shallower over soft bedrock than Assinniboine and Twilight soils. They are more sandy than Cabbart and Scroggin soils.

Boneek Series

The Boneek series consists of deep, gently sloping to moderately steep, well-drained silty soils on high terraces and uplands. These soils formed in silty material that is underlain by sandstone and siltstone.

In a representative profile the surface layer is brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. It is brown silty clay in the upper part, brown silty clay loam in the middle, and calcareous, pale-brown silty clay loam in the lower part. The upper part is very hard when dry and friable when moist. The lower part contains many spots of soft lime. The underlying material to a depth of 44 inches is calcareous, light brownish-gray silty clay loam and silt loam. Below this is light yellowish-brown sandstone.

Boneek soils have medium fertility and moderate available water capacity. Permeability is moderate, and runoff is medium.

Some areas are cultivated. Small grain and alfalfa are the main crops. Other areas are in native grass and are used for range. The native vegetation is mainly mid and short grasses.

Representative profile of Boneek silt loam, 2 to 6 percent slopes, in native grass, 1,005 feet east and 100 feet north of the southwest corner of sec. 3, T. 8 N., R. 1 E.:

A11—0 to 3 inches, brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; moderate, thin, platy structure parting to weak, fine, granular; slightly hard, very friable; many roots; slightly acid; clear, wavy boundary.

A12—3 to 6 inches, brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure; hard, very friable; many roots; slightly acid; clear, wavy boundary.

B21t—6 to 10 inches, brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/2) crushing to dark brown (7.5YR 4/4) moist; moderate, medium, prismatic structure parting to moderate, medium and fine, subangular blocky; very hard, friable, slightly sticky and plastic; common roots; thin continuous clay films on faces of peds; slightly acid; clear, wavy boundary.

B22t—10 to 15 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium and fine, subangular blocky; very hard, friable, slightly sticky and slightly plastic; common roots; thin continuous clay films on faces of peds; mildly alkaline; clear, wavy boundary.

B3ca—15 to 24 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, friable, slightly sticky and slightly plastic; common roots; many fine and medium segregations of lime; violent effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—24 to 34 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; weak, medium and coarse, subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; few roots; common fine and medium segregations of lime; violent effervescence; strongly alkaline; gradual, wavy boundary.

C2—34 to 44 inches, light brownish-gray (2.5Y 6/2) silt loam in upper 8 inches, grayish brown (2.5Y 5/2) moist, and gray (2.5Y 5/1) and light brownish-gray (2.5Y 6/2) silt loam in lower 2 inches, dark gray (2.5Y 4/1) and grayish brown (2.5Y 5/2) moist; few, fine and medium, prominent mottles of strong brown (7.5YR 5/8); very weak, coarse, subangular blocky structure; very hard, friable; few roots; many fragments of sandstone in lower 2 inches; violent effervescence; moderately alkaline; abrupt, wavy boundary.

C3—44 to 54 inches, light yellowish-brown (10YR 6/4) sandstone, dark yellowish brown (10YR 4/4) moist; bedded, thin, platy structure; fracture faces stained strong brown (7.5YR 5/6) moist; few coatings of lime on fracture faces, but matrix is noncalcareous; strongly alkaline.

Depth to bedrock is more than 40 inches and in places is more than 60 inches, and depth to carbonates ranges from 11 to 24 inches. The solum ranges from about 20 to 31 inches in thickness. The A1 horizon is grayish brown or brown in hue of 10YR or 7.5YR. It is silt loam or loam and ranges from 5 to 8 inches in thickness. The B21t horizon ranges from brown to light reddish brown in hue of 7.5YR or 5YR. It is heavy silty clay loam or silty clay that ranges from 35 to 42 percent clay and is less than 15 percent fine sand or coarser. It has moderate or strong structure. The B22t horizon ranges from reddish gray to light yellowish brown in hue of 10YR or 7.5YR. It ranges from 24 to 35 percent clay and is less than 15 percent fine sand or coarser. It has weak or moderate structure. The B3ca and C horizons range from gray to light yellowish brown in hue of 10YR or 2.5Y. They have few to many fine or medium segregations of lime. The C horizon is mainly silty clay loam or silt loam, but in places it is loam or is weakly stratified with loam and fine sandy loam.

Boneek soils are mapped with Butche soils and are near Canyon, Colby, Keith, and Lakoa soils. They are deeper over sandstone than Butche, Canyon, and Lakoa soils and they do not have the A2 horizon that is characteristic of Lakoa soils. They have a B horizon, which does not occur in Colby soils, and a thicker A horizon. They have a B2t horizon that contains more clay and has colors in redder hues than Keith soils. They differ from the similar Vale soils in having more yellow hues in the B3 and C horizons.

Boneek silt loam, 2 to 6 percent slopes (BsB).—This soil is on high terraces and uplands. Areas are irregular in shape and range from 10 to 800 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of soils that are similar to this Boneek soil, but depth

to carbonates is less than 10 inches. Also included are areas of soils that are similar to this Boneek soil, but are less than 40 inches deep over bedrock.

This soil has medium fertility. It has moderate available water capacity. Runoff is medium. Some risk of erosion occurs in cultivated areas.

Winter wheat, barley, oats, and alfalfa are the main crops in cultivated areas. Other areas are in native grass and are used for grazing. Control of erosion is the main concern in management. Silty range site; capability unit IIIe–1; windbreak group 3.

Boneek silt loam, 6 to 9 percent slopes (BsC).—This soil is on high terraces and uplands. Areas range from 10 to 100 acres in size.

Included with this soil in mapping are areas of soils similar to this Boneek soil, but depth to lime is less than 10 inches. Also included are areas of soils that are less than 40 inches deep over bedrock.

This Boneek soil has medium fertility. Available water capacity is moderate. Runoff is medium. Cultivated areas are susceptible to erosion.

Many areas are in native grass and are used for range. Small grain and alfalfa are the main crops. Control of erosion is the main concern in management. Silty range site; capability unit IVe–1; windbreak group 3.

Broadhurst Series

The Broadhurst series consists of deep, nearly level to gently sloping, well-drained, acid clayey soils. These soils are on fans and terraces. They formed in clayey alluvium derived from acid shale.

In a representative profile the surface layer is light brownish-gray clay about 3 inches thick. The underlying material is grayish-brown clay. To a depth of 36 inches it is very hard when dry and very firm when moist. Below a depth of 36 inches it contains fine fragments of shale and nests of salt and gypsum crystals. The entire profile is very strongly acid.

Broadhurst soils have low fertility and low or moderate available water capacity. Permeability is very slow, and runoff is slow or medium.

These soils are used for range. The native vegetation is mainly sagebrush and western wheatgrass.

Representative profile of Broadhurst clay, 0 to 6 percent slopes, in native grass, 1,440 feet west and 1,880 feet north of the southeast corner of sec. 4, T. 9 N., R. 1 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) clay, very dark grayish brown (10YR 3/2) moist; weak, thick, platy structure; hard, very firm, sticky and plastic; few roots; very strongly acid; abrupt, smooth boundary.

C1—3 to 17 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) crushing to dark grayish brown (10YR 4/2) moist; weak, coarse, blocky and subangular blocky structure; very hard, very firm, sticky and plastic; few roots; very strongly acid; gradual, smooth boundary.

C2—17 to 36 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) crushing to dark grayish brown (10YR 4/2) moist; very weak, coarse, blocky and subangular blocky structure; very hard, very firm, sticky and plastic; very strongly acid; clear, smooth boundary.

C3—36 to 60 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) crushing to dark grayish brown (10YR 4/2) moist; massive; slightly hard, very firm, sticky and plastic; common fine shale fragments; common fine salt and gypsum crystals; very strongly acid.

Colors throughout the profile are inherited from the acid shale. Clay content between depths of 10 and 40 inches ranges from 60 to 70 percent. When the soil is dry, cracks ½ to 1 inch wide and several feet long extend downward for 20 inches or more. The soil commonly is very strongly acid, but the A1 horizon in some places is neutral or mildly alkaline. The A1 horizon ranges from gray to light brownish gray in hue of 10YR or 2.5Y. It contains less than 1 percent more organic matter than the C horizon. The C horizon ranges from grayish brown to light olive gray in hues of 10YR to 5Y. Few or common fine fragments of shale are in some places. Few or common segregations of gypsum and salts are in the C3 horizon.

Broadhurst soils are near Demar, Graner, and Grummit soils. They do not have the columnar structure in the B2t horizon that is characteristic of Demar soils. They are very hard and do not have the friable consistence of Graner soils. They are deeper over shale than Grummit soils.

Broadhurst clay, 0 to 6 percent slopes (BtB).—This soil is on fans and terraces. Areas are irregular in shape and commonly are 40 acres or more in size. Small gullies are common.

Included with this soil in mapping are areas of Graner soils and Saline-Alkali land. Graner soils are on some of the fans. Saline-Alkali land is along drainageways.

This Broadhurst soil takes in water slowly and releases moisture slowly to plants. Tilth is poor. Runoff is slow or medium, depending on slope.

This soil is in native grass and is used for range. It is not suitable for cultivation. Dense Clay range site; capability unit VIs–6; windbreak group 10.

Butche Series

The Butche series consists of shallow, sloping to very steep, well-drained to excessively drained loamy soils on uplands. These soils formed in material weathered from siltstone, sandstone, and shale.

In a representative profile the surface layer is brown very fine sandy loam about 3 inches thick. The underlying material to a depth of 16 inches is light yellowish-brown very fine sandy loam. It is very hard when dry and friable when moist. The lower part contains fragments of sandstone. Below a depth of 16 inches is bedded siltstone and sandstone (fig. 9).

Butche soils have low fertility and very low available water capacity. Permeability is moderate above the bedrock, and runoff is medium or rapid.

Almost all the areas are in native vegetation and are used for range. The native vegetation is mainly short and mid grasses. Ponderosa pine, growing singly or in clumps, is scattered throughout many areas.

Representative profile of Butche very fine sandy loam in an area of Butche-Boneek complex, 6 to 25 percent slopes, in grass, 2,100 feet west and 800 feet south of the northeast corner of sec. 6, T. 7 N., R. 2 E.:

A1—0 to 3 inches, brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak, thin, platy structure; hard, friable; common roots; many pieces

Figure 9.—**Profile of Butche very fine sandy loam showing bedded siltstone and sandstone.**

of slabby sandstone on surface; neutral; abrupt, smooth boundary.

C1—3 to 9 inches, light yellowish-brown (10YR 6/4) very fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; very hard, friable; common roots; neutral; abrupt, smooth boundary.

C2—9 to 16 inches, light yellowish-brown (10YR 6/4) very fine sandy loam, yellowish brown (10YR 5/4) moist, interspersed with channery fragments of reddish-yellow (7.5YR 6/6) sandstone, reddish yellow (7.5YR 6/6) moist; brown (7.5YR 5/4) coatings on sandstone, dark brown (7.5YR 4/4) moist; massive; fine earth is very hard and friable, sandstone is brittle; few roots; neutral; abrupt, smooth boundary.

R1—16 to 20 inches, gray (10YR 6/1) and pale-brown (10YR 6/3) siltstone, dark gray (10YR 4/1) and brown (10YR 5/3) moist; massive; very hard, friable; neutral; abrupt, smooth boundary.

R2—20 to 25 inches, brown (7.5YR 4/4), strong-brown (7.5YR 5/6), light yellowish-brown (10YR 6/4), and brownish-yellow (10YR 6/6) brittle, slabby sandstone; white lime coatings on fracture faces; slight effervescence; moderately alkaline.

Depth to bedrock ranges from 6 to 20 inches. Stones and fragments of sandstone are common on the surface and throughout the profile above the bedrock. The lower part of the C horizon is calcareous in some places. The A1 horizon ranges from grayish brown to light brown in hue of 10YR or 7.5YR. It is very fine sandy loam or loam and ranges from 2 to 4 inches in thickness. The C horizon ranges from grayish brown to reddish yellow in hue of 10YR or 7.5YR. It is silt loam, loam, or very fine sandy loam that is 18 to 27 percent clay. The R horizon is siltstone or sandstone.

Butche soils are mapped with Boneek soils and are near Canyon, Colby, Keith, Lakoa, Nevee, and Spearfish soils. They are more shallow over bedrock than Boneek, Colby, Keith, Lakoa, and Nevee soils. They are less calcareous than Canyon and Spearfish soils.

Butche-Boneek complex, 6 to 25 percent slopes (BuD).—This mapping unit is about 60 percent Butche soils, 20 percent Boneek soils, and 20 percent other soils. Areas are irregular in shape and range from 50 to 1,000 acres in size. The Butche soil is on the higher and steeper parts of the landscape. It has the profile described as representative of the Butche series. The Boneek soil is less steep. It has a profile similar to the one described as representative of the Boneek series, but in places the depth to bedrock is less than 40 inches.

Included with these soils in mapping are areas of Keith, Midway, and Razor soils and Rock outcrop. Keith soils are on some of the less steep parts of the landscape. Midway and Razor soils are in areas that are underlain by shale. Rock outcrop is in the form of sandstone ledges in the higher and steeper parts of the landscape.

Runoff is medium or rapid. The soils are susceptible to erosion. Butche soils are too shallow for cultivation.

Most of the acreage is in native grass and is used for range. Winter wheat is the main crop in cultivated areas, which are mostly on the Boneek soil. Butche soil in Shallow range site, capability unit VIs-1, and windbreak group 10; Boneek soil in Silty range site, capability unit IVe-1, and windbreak group 3.

Butche-Rock outcrop complex, 25 to 50 percent slopes (BvF).—This mapping unit is about 60 percent Butche soils, 15 to 25 percent Rock outcrop, and 15 to 25 percent other soils. Areas are long and narrow and range from 50 to 500 acres in size. Stones as much as 3 feet in diameter commonly are on the surface. Areas of Rock outcrop are mostly ledges of sandstone that crop out on the upper parts of the landscape (fig. 10).

Included with these soils in mapping are areas of Lakoa and Midway soils. Lakoa soils are on the middle and lower parts of some areas. Midway soils are in areas where shale is at a shallow depth. Also included are shallow soils that are more sandy than Butche soils.

These soils have low fertility. They are very droughty. They are not suitable for cultivation.

All of the acreage is in native vegetation and is used for range. Butche soil in Shallow range site, capability unit VIIs-1, and windbreak group 10; Rock outcrop in capability unit VIIIs-1 and not assigned to a range site or windbreak group.

Cabbart Series

The Cabbart series consists of shallow, sloping to steep, well-drained to excessively drained, calcareous loamy soils on uplands. These soils formed in material weathered from sandstone, siltstone, and shale.

Figure 10.—**Vertical faces of Rock outcrop are a characteristic of Butche-Rock outcrop complex, 25 to 50 percent slopes.**

In a representative profile the surface layer is yellowish-brown loam about 2 inches thick. The underlying material to a depth of about 13 inches is light brownish-gray and light-gray loam that is slightly hard when dry and very friable when moist. Below a depth of 13 inches is calcareous, light-gray siltstone and fine-grained sandstone.

Cabbart soils have low fertility and very low available water capacity. Permeability is moderate above the bedrock, and runoff is medium or rapid.

These soils are used mainly for range. The native vegetation is mainly short and mid grasses, sedges, and pricklypear cactus.

Representative profile of Cabbart loam in an area of Cabbart-Scroggin loams, 6 to 25 percent slopes, in native grass, 2,150 feet north and 1,550 feet east of the southwest corner of sec. 36, T. 12 N., R. 8 E.:

A1—0 to 2 inches, yellowish-brown (10YR 5/4) loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; many roots; slight effervescence; moderately alkaline; clear, smooth boundary.

C1—2 to 10 inches, light brownish-gray (2.5Y 6/2) loam, olive brown (2.5Y 4/4) and thin band of yellowish brown (10YR 5/6) moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable; many roots in upper 2 inches, common roots in lower 6 inches; strong effervescence; moderately alkaline; clear, smooth boundary.

C2ca—10 to 13 inches, light-gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; weak, medium and fine, subangular blocky structure; slightly hard, very friable; common roots; violent effervescence; strongly alkaline; clear, wavy boundary.

C3—13 to 20 inches, light-gray (2.5Y 7/2) interbedded siltstone and fine-grained sandstone, olive (5Y 5/3) moist; many, fine, yellowish-brown (10YR 5/6) mottles; slightly hard, very friable; very few roots in upper part; pockets of gypsum between structure faces of the bedrock; strong effervescence; strongly alkaline.

Depth to bedrock ranges from 8 to 20 inches, and depth to free carbonates ranges from 0 to 8 inches. The A1 horizon ranges from grayish brown to pale olive in hues of 10YR to 5Y and from very fine sandy loam to silty clay loam. It ranges from 1 to 4 inches in thickness. The C horizon ranges from grayish brown to pale yellow in hues of 10YR to 5Y. The C1 and C2 horizons range from loam to silty clay loam and are 18 to 35 percent clay. The bedrock is soft sandstone, siltstone, or shale.

Cabbart soils are mapped with Lismas and Scroggin soils and are near Absher, Assinniboine, Blackhall, Oburn, Ralph, and Twilight soils. They do not have the columnar structure that is characteristic of Absher and Oburn soils. They contain less sand than Assinniboine, Blackhall, and Twilight soils and are less clayey than Lismas soils. They are shallower over bedrock than Ralph and Scroggin soils.

Figure 11.—Cabbart-Rock outcrop complex, 25 to 50 percent slopes, along an entrenched drainageway in Cabbart-Absher soil association.

Cabbart loam, 25 to 40 percent slopes (CaF).—This soil is in irregularly shaped areas commonly less than 35 acres in size. Many areas are laced with small gullies.

Included with this soil in mapping are areas of Blackhall soils and Rock outcrop. Blackhall soils are in the more sandy areas near outcrops of sandstone. Areas of Rock outcrop are exposures of sandstone or shale on the upper parts of the landscape or around the heads of drainageways.

This Cabbart soil has low fertility and is droughty. Runoff is rapid, and the risk of erosion is high.

All the acreage is in native grass and is used for range. Shallow range site; capability unit VIIs-1; windbreak group 10.

Cabbart-Lismas complex, 6 to 18 percent slopes (CbD).—This mapping unit is about equal proportions of Cabbart and Lismas soils. It is on the sides of ridges and entrenched drainageways. Areas commonly are long and narrow and are less than 150 acres in size. Many small gullies are common. The Cabbart soil is on the higher parts of the landscape. The Lismas soil is below the Cabbart soil. It has a profile similar to the one described as representative of the Lismas series, but in many places the surface layer is loam or clay loam.

Included with these soils in mapping are areas of Blackhall and Pierre soils. Blackhall soils are intermingled with Cabbart soils. Pierre soils are intermingled with Lismas soils.

These soils have low fertility and very low available water capacity. Runoff is rapid, and the hazard of erosion is high.

All the acreage is in native grass and is used for range. Capability unit VIs-1; windbreak group 10; Cabbart soil in Shallow range site, Lismas soil in Shallow Dense Clay range site.

Cabbart-Rock outcrop complex, 25 to 50 percent slopes (CcF).—This mapping unit is about 50 percent Cabbart soils, 40 percent Rock outcrop, and 10 percent other soils. It is mainly on sides of entrenched drainageways (fig. 11). Areas are long and narrow, and many have actively eroding gullies. Stones are on the surface in some areas. The Cabbart soil is on narrow ridges and the less steep and less eroded sides of the drainageways. Rock outcrop is steeper and consists of sandstone outcrops and eroding exposures of soft shale.

Included with these soils in mapping are areas of Absher, Blackhall, and Scroggin soils. Absher soils are on fans on foot slopes and on low terraces. Blackhall and Scroggin soils are intermingled with Cabbart soils. Also included, in some areas, are narrow strips of Loamy alluvial land on bottom land along drainageways.

Runoff is rapid on the Cabbart soil and very rapid on Rock outcrop. The hazard of erosion is high, and geologic erosion is active.

All the acreage is used for range. The Rock outcrop part of the mapping unit has little or no vegetation. Cabbart soil in Shallow range site, capability unit VIs-1, and windbreak group 10; Rock outcrop in capability unit VIIIs-1 and not assigned to a range site or windbreak group.

Cabbart-Scroggin loams, 6 to 25 percent slopes (CgD).—This mapping unit is about 50 percent Cabbart soils, 30 percent Scroggin soils, and 20 percent other soils. Areas are irregular in shape and range from 10 to 300 acres in size. Small gullies occur in some areas. The Cabbart soil is on the top and upper sides of ridges and knolls. The Scroggin soil is on the lower parts of the landscape, below areas of the Cabbart soils. These soils have the profiles described as representative of the Cabbart and Scroggin series.

Included with these soils in mapping are areas of Absher, Blackhall, and Ralph soils and, in some areas, Loamy alluvial land and Slickspots. Absher soils and Slickspots are on foot slopes and in swales. Blackhall soils are on some ridges with Cabbart soils. Ralph soils are on some foot slopes. Loamy alluvial land is in some larger swales and on the bottoms of drainageways.

These soils have low fertility and are droughty. Runoff is medium or rapid, depending on slope.

Almost all the acreage is in native grass and is used for range. Capability unit VIs-1; windbreak group 10; Cabbart soil in Shallow range site, Scroggin soil in Thin Upland range site.

Canyon Series

The Canyon series consists of shallow, sloping to very steep, well-drained, calcareous loamy soils on uplands. These soils formed in material weathered from light-colored, calcareous siltstone, sandstone, and shale.

In a representative profile the surface layer is light brownish-gray silt loam about 2 inches thick. Below this is a 7-inch transition layer of light brownish-gray very fine sandy loam that is soft when dry and very friable when moist. The underlying material to a depth of 14 inches is light brownish-gray very fine sandy loam. Below a depth of 14 inches is white sandstone. The profile is calcareous throughout.

Canyon soils have low fertility and very low available water capacity. Permeability is moderate above the bedrock, and runoff is medium or rapid.

Areas of these soils are used almost exclusively for range. The native vegetation is mainly mid and short grasses and sedges. Ponderosa pine, growing singly or in clumps, is scattered throughout many areas.

Representative profile of Canyon silt loam in an area of Colby-Canyon silt loams, 6 to 25 percent slopes, in native grass, 200 feet west and 1,600 feet north of the southeast corner of sec. 32, T. 8 N., R. 1 E.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; loose; common roots; violent effervescence; mildly alkaline; clear, smooth boundary.

AC—2 to 9 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, medium and coarse, subangular blocky structure; soft, very friable; common roots; violent effervescence; mildly alkaline; gradual, wavy boundary.

C1—9 to 14 inches, light brownish-gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; few roots; violent effervescence; mildly alkaline; gradual, wavy boundary.

C2—14 to 24 inches, white (2.5Y 8/2) weakly cemented sandstone, light gray (2.5Y 7/2) moist; bedded; violent effervescence; mildly alkaline.

Depth to bedrock ranges from 8 to 20 inches. Fragments of sandstone or siltstone commonly are on the surface and throughout the profile. The A1 horizon ranges from brown or grayish brown to light yellowish brown in hues of 7.5YR to 2.5Y. It is very fine sandy loam, loam, or silt loam and in places is noncalcareous. The AC and C1 horizons range from brown or grayish brown to pale yellow in hues of 7.5YR to 2.5Y. These horizons are very fine sandy loam, loam, or silt loam and are 18 to 27 percent clay. The underlying bedrock in most areas is weakly cemented, calcareous sandstone that ranges from gray to white, pink, or pale yellow in hues of 7.5YR to 2.5Y.

Canyon soils are mapped with Colby soils and are near Boneek, Butche, Keith, Nevee, and Spearfish soils. They are more shallow over bedrock than Boneek, Colby, Keith, and Nevee soils. They are more calcareous than Butche soils. They have colors in less reddish hues than Spearfish soils.

Canyon-Colby complex, 25 to 50 percent slopes (CIF).—This mapping unit is about 50 percent Canyon soils, 25 percent Colby soils, and 25 percent other soils. Areas are irregular in shape and range from 10 to 700 acres in size. Canyon soils are on the tops and upper sides of ridges. The Colby soil is on the lower parts of the landscape. Both soils have profiles similar to the ones described as representative of their respective series, but in many areas stones are on the surface.

Included with these soils in mapping are areas of Keith and Lakoa soils and Rock outcrop. Keith soils are in swales and on foot slopes near Colby soils. Lakoa soils are in protected covelike positions vegetated with ponderosa pine. Areas of Rock outcrop commonly are immediately below ridgetops and include small areas of rubble. Also included are areas of a soil that is similar to the Colby soil, but sandstone or shale is at a depth of less than 40 inches.

Canyon and Colby soils have low fertility. Canyon soils have very low available water capacity. Runoff is rapid, and the risk of erosion is high.

All the acreage is in native vegetation and is used for range. Scattered ponderosa pines, growing singly or in clumps, commonly are in the areas. Capability unit VIIs-1; windbreak group 10; Canyon soil in Shallow range site, Colby soil in Thin Upland range site.

Caputa Series

The Caputa series consists of deep, nearly level to sloping, well-drained loamy soils on upland divides and high terraces. These soils formed in clayey alluvium of mixed origin.

In a representative profile the surface layer is brown loam about 9 inches thick. The subsoil, about 25 inches thick, is clay loam that is grayish brown in the upper part and gray in the lower part. It is very hard when dry and firm when moist. The lower part is calcareous and contains many white spots of lime that extend into the underlying material. The underlying material is calcareous, gray clay loam.

Caputa soils have medium fertility and moderate or high available water capacity. Permeability is moderately slow, and runoff is slow or medium.

Caputa soils are used for range, hay, and dry-farmed crops. Winter wheat, oats, and alfalfa are the main crops in cultivated areas. The native vegetation is mainly mid and short grasses.

Representative profile of Caputa loam, 0 to 2 percent slopes, in crops, 1,000 feet west and 2,240 feet north of the southeast corner of sec. 17, T. 8 N., R. 3 E.:

Ap—0 to 6 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; hard, friable, slightly sticky; many roots; slightly acid; abrupt, smooth boundary.

A12—6 to 9 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, medium and coarse, subangular blocky structure; hard, friable, slightly sticky; common roots; thin patchy clay films; slightly acid; clear, wavy boundary.

B21t—9 to 18 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm, sticky; common roots; moderately thick continuous clay films on vertical and horizontal faces of peds; slightly acid; clear, wavy boundary.

B22tca—18 to 22 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm, sticky; few roots; thin continuous clay films on vertical faces of peds; many coarse segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

B3ca—22 to 34 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; weak, coarse, prismatic structure; very hard, firm, slightly sticky; few roots; thin patchy clay films on vertical faces of peds; many coarse segregations of lime; strong effervescence; mildly alkaline; gradual boundary.

C1ca—34 to 46 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; massive; very hard, friable, slightly sticky; few roots; many coarse segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C2—46 to 60 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; massive; hard, friable, slightly sticky; few medium segregations of lime; strong effervescence; mildly alkaline.

The solum ranges from 16 to 40 inches in thickness. Depth to carbonates ranges from 10 to 22 inches. A few pebbles commonly are throughout the profile. The A horizon ranges from dark grayish-brown to brown loam or light clay loam that is 5 to 10 inches thick. The B2t horizon ranges from dark grayish brown to pale brown in hue of 10YR or 2.5Y. It is clay loam or clay that is 35 to 45 percent clay. The B2t horizon has weak or moderate, prismatic structure parting to moderate or strong, blocky. In a few places the lower part of the B2t horizon is noncalcareous. The B2t horizon ranges from 7 to 15 inches thick. The B3ca horizon ranges from brown to light yellowish brown in hues of 7.5YR to 2.5Y. The B3ca and Cca horizons have common or many segregations of lime that range from fine to coarse. The C horizon ranges from loam to clay. In places it is stratified with finer textured or coarser textured material.

Caputa soils are near Redig and Satanta soils. They formed in material similar to that in which Bidman soils formed. They have a darker colored A horizon than Bidman and Redig soils, and they contain less gypsum than Redig soils. They contain more clay in the B horizon than Satanta soils.

Caputa loam, 0 to 2 percent slopes (CmA).—This soil is on upland divides and high terraces. Areas are irregular in shape and range from 20 to 1,000 acres in size. This soil has the profile described as representative of the series, but in some cultivated areas the surface layer is clay loam. Included in mapping are some areas of Satanta soils on slight rises.

This soil has medium fertility. The available water capacity is moderate or high. Runoff is slow.

Areas of this soil are used for range and dry-farmed crops. Winter wheat, oats, and alfalfa are the main crops. Conservation of moisture is the main concern in management. Clayey range site; capability unit IIIc-1; windbreak group 3.

Caputa loam, 2 to 6 percent slopes (CmB).—This soil is on upland divides and high terraces. Areas are irregular in shape and range from 10 to 500 acres in size. This soil has a profile similar to the one described as representative of the series, but in some cultivated areas the surface layer is clay loam.

Included with this soil in mapping are areas of Satanta soils, commonly near the crests of slopes.

This Caputa soil has medium fertility. The available water capacity is moderate or high. Runoff is medium. There is some risk of erosion.

Areas of this soil are used for range and dry-farmed crops. Winter wheat, oats, and alfalfa are the main crops in cultivated areas. Control of erosion is the main concern in management. Clayey range site; capability unit IIIe-1; windbreak group 3.

Caputa loam, 6 to 9 percent slopes (CmC).—This soil is on upland divides and high terraces. Areas are irregular in shape and range from 10 to 200 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer commonly is thinner.

Included with this soil in mapping are areas of Redig soils, commonly on ridges and knolls in the higher parts of the landscape.

This Caputa soil has medium fertility. The available water capacity is moderate or high. Runoff is medium. The risk of erosion is high in cultivated areas.

Most of the acreage is in native grass and is used for range. Winter wheat, oats, and alfalfa are the main crops in cultivated areas. Control of erosion is the main concern in management. Clayey range site; capability unit IVe-1; windbreak group 3.

Chinook Series

The Chinook series consists of deep, nearly level, well-drained loamy soils. These soils are on terraces and fans. They formed in sandy alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 5 inches thick. The subsoil, about 13 inches thick, is fine sandy loam that is brown in the upper part and grayish brown in the lower part. The upper part is hard when dry and very friable when moist. The underlying material is grayish-brown and light brownish-gray stratified loam, fine sandy loam, and sandy loam. It is calcareous and has spots and masses of lime beteen depths of 21 and 26 inches.

Chinook soils have medium fertility and moderate or high available water capacity. Permeability is moderately rapid, and runoff is slow. Soil blowing is a hazard.

Most areas are used for range. The native vegetation is mainly mid and short grasses.

Representative profile of Chinook fine sandy loam, 0 to 3 percent slopes, in native grass, 2,640 feet west and 1,060 feet south of the northeast corner of sec. 24, T. 14 N., R. 7 E.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; very weak, fine, granular structure; loose, very friable; many roots; neutral; clear, smooth boundary.

A12—3 to 5 inches, grayish-brown (10 YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, very friable; many roots; neutral; clear, smooth boundary.

B2—5 to 15 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure parting to weak, medium, subangular blocky; hard, very friable; common roots; thin patchy clay films on vertical faces of peds and clay bridges between sand grains; neutral; clear, smooth boundary.

B3—15 to 18 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; common roots; mildly alkaline; clear, smooth boundary.

C1—18 to 21 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to weak, coarse, subangular blocky; hard, friable; few roots; slight effervescence; mildly alkaline; clear, smooth boundary.

C2ca—21 to 26 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, subangular blocky structure; hard, very friable; few roots; common, fine, white segregations of lime; strong effervescence; moderately alkaline; clear, smooth boundary.

C3—26 to 60 inches, grayish-brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 15 to 27 inches in thickness. Depth to free carbonates ranges from 15 to 25 inches. The A horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. It commonly is fine sandy loam, but in places it is sandy loam, very fine sandy loam, or loam. The B2 horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. It commonly is fine sandy loam and ranges from 12 to 18 percent clay. The B2 horizon has weak or moderate, prismatic structure. The C horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is fine sandy loam or sandy loam and commonly is stratified with loamy fine sand, loam, or silt loam.

Chinook soils are near Archin, Assinniboine, Parshall, and Sorum soils. They have a less clayey B horizon than Archin and Sorum soils. They contain less clay and more sand in the B horizon than Assinniboine soils. They differ from Parshall soils in having thinner horizons that have colors of very dark grayish brown or darker when moist.

Chinook fine sandy loam, 0 to 3 percent slopes (CnA).—This soil is on terraces and fans. Areas are irregular in shape and range from 5 to 250 acres in size.

Included with this soil in mapping are areas of Assinniboine and Sorum soils. Assinniboine soils are intermingled with Chinook soils. Sorum soils are in slight depressions.

This Chinook soil takes in water readily and has moderate or high available water capacity. However, it blows easily in cultivated areas.

Most of the acreage is in native grass and is used for range. Control of soil blowing is the main concern in management. Sandy range site; capability unit IVe–6; windbreak group 5.

Colby Series

The Colby series consists of deep, sloping to steep, well-drained silty soils on uplands. These soils formed in deep, calcareous silty material.

In a representative profile the surface layer is brown silt loam about 4 inches thick. Below this is an 8-inch transition layer of calcareous, light-gray silt loam. It is soft when dry and very friable when moist. The underlying material to a depth of 42 inches is calcareous, white silt loam. Below a depth of 42 inches is calcareous, light-gray loamy very fine sand.

Colby soils have low fertility and moderate or high available water capacity. Permeability is moderate, and runoff is medium or rapid. Erosion and soil blowing are severe hazards.

Most areas are in native vegetation and are used for range. A few areas are cultivated. Winter wheat and alfalfa are the main crops. The native vegetation is mainly short and mid grasses.

Representative profile of Colby silt loam in an area of Colby-Canyon silt loams, 6 to 25 percent slopes, in native grass, 1,790 feet south and 200 feet west of the northeast corner of sec. 32, T. 8 N., R. 1 E.:

A1—0 to 4 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; common roots; neutral; clear, wavy boundary.

AC—4 to 12 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; very weak, very coarse, subangular blocky structure; soft, very friable; common roots; violent effervescence; mildly alkaline; gradual, wavy boundary.

C1—12 to 42 inches, white (10YR 8/2) silt loam, light gray (10YR 7/2) moist; massive; soft, very friable; few roots; violent effervescence; mildly alkaline; gradual, wavy boundary.

C2—42 to 60 inches, light-gray (10YR 7/2) loamy very fine sand, pale brown (10YR 6/3) moist; massive; soft, very friable; many fine segregations of lime; violent effervescence; mildly alkaline.

Depth to bedrock is more than 40 inches, and depth to carbonates is less than 6 inches. The A horizon ranges from brown or grayish brown to pale yellow in hues of 7.5YR to 2.5Y. It is silt loam or very fine sandy loam and ranges from 3 to 6 inches in thickness. The AC and C horizons range from brown or grayish brown to white or pale yellow in hues of 7.5YR to 2.5Y. They are silt loam, loam, or very fine sandy loam and range from 18 to 25 percent clay.

Colby soils are mapped with Canyon soils and are near Keith soils. They are deeper over bedrock than Canyon soils. They have a thinner A horizon and are shallower over lime than Keith soils.

Colby-Canyon silt loams, 6 to 25 percent slopes (CoD).—This mapping unit is about 50 percent Colby soils, 30 percent Canyon soils, and 20 percent other soils. Areas are irregular in shape and range from 10 to 400 acres in size. Small areas that have cobblestones and stones on the surface are common in many of the mapped areas. The stones range to as much as several feet in diameter. They are indicated on the maps by a special feature symbol. The Colby soil is sloping to strongly sloping and is on the lower parts of the landscape. The Canyon soil is on the higher and commonly steeper parts of the complex. These soils have the profiles described as representative of the Colby and Canyon series.

Included with these soils in mapping are areas of Keith soils that make up as much as 20 percent of some areas. They are in swales and on foot slopes and fans near Colby soils. Also included are areas of a soil that is similar to this Colby soil, but sandstone or shale is at a depth between 20 and 40 inches; and areas of clayey soils underlain by clay shale.

Colby and Canyon soils have low fertility. They take in water readily, but the Canyon soil has very low available water capacity. Runoff is medium or rapid, depending on slope. The soils are subject to erosion and soil blowing.

Most of the acreage is in native vegetation and is used for range. A few small areas are cultivated. Small grain and alfalfa are the main crops. Scattered ponderosa pines, growing singly or in clumps, are in some areas. Capability unit VIe-3; windbreak group 10; Colby soil in Thin Upland range site, Canyon soil in Shallow range site.

Demar Series

The Demar series consists of deep, nearly level to gently sloping, moderately well drained, acid soils that have a claypan. These soils are on terraces and fans. They formed in alluvium derived from acid clay shale.

In a representative profile the surface layer is pale-brown loam about 5 inches thick. The subsoil, about 27 inches thick, is brown silty clay loam in the upper part and grayish-brown silty clay in the lower part. It is very hard when dry and very firm when moist. The lower part contains nests of gypsum. The underlying material to a depth of 41 inches is light brownish-gray shaly clay that has many mottles of brownish yellow and bands of gypsum crystals. Below a depth of 41 inches is light brownish-gray clay shale. Except for the surface layer, the entire profile is acid.

Demar soils have low fertility and available water capacity. Permeability is very slow, and runoff is medium.

These soils are used for range. The native vegetation is mainly short and mid grasses, sagebrush, and pricklypear cactus.

Demar soils in Butte County are mapped only in complex with Slickspots.

Representative profile of Demar loam in an area of Slickspots-Demar complex, 0 to 6 percent slopes, in native grass, 150 feet north and 1,440 feet east of the southwest corner of sec. 33, T. 9 N., R. 2 E.:

A2—0 to 5 inches, pale-brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; very weak, thin, platy structure parting to weak, fine, granular; slightly hard, friable, slightly sticky; many roots; neutral; abrupt, wavy boundary.

B21t—5 to 12 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, columnar structure; very hard, very firm, sticky and plastic; light-gray (10YR 7/2) coatings on column tops; thin patchy clay films on faces of peds; few roots; medium acid; clear, smooth boundary.

B22t—12 to 24 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate, medium, blocky structure; very hard, very firm, sticky and plastic; thin continuous clay films on faces of peds; very few roots; very strongly acid; clear, smooth boundary.

B3cs—24 to 32 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; few, fine, prominent, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; very hard, very firm, sticky and plastic; very few roots; common fine nests of gypsum; extremely acid; gradual, smooth boundary.

C1cs—32 to 41 inches, light brownish-gray (10YR 6/2) shaly clay, dark grayish brown (10YR 4/2) moist; many, coarse, prominent, brownish-yellow (10YR 6/6) mottles; weak, coarse, subangular blocky structure; very hard, very firm; 30 to 50 percent fragments of partly weathered shale, by volume; common bands, about 3 millimeters thick, of gypsum crystals; extremely acid; gradual, smooth boundary.

C2—41 to 50 inches, light brownish-gray (10YR 6/2) clay shale, grayish brown (10YR 5/2) moist; bedded platy structure; very hard; many, coarse, prominent, brownish-yellow (10YR 6/6) and yellowish-brown (10YR 5/6) iron stains on fracture faces; extremely acid.

The solum ranges from 16 to 36 inches in thickness. Depth to unweathered shale ranges from 36 to 50 inches. The soil ranges from neutral to strongly acid in the upper 12 inches and is very strongly acid or extremely acid below that depth. The A2 horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y and is 3 to 8 inches thick. The B2t horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y and is 35 to 60 percent clay. The B21t horizon has weak or moderate, medium or coarse, columnar structure; and the B22t horizon has moderate or strong, medium or coarse, blocky. The B3cs and C1cs horizons contain common or many nests and bands of gypsum crystals.

Demar soils are mapped with Slickspots; are near Broadhurst, Graner, and Grummit soils; and are similar to Arvada and Hisle soils. They are more acid than Arvada and Hisle soils. They differ from Broadhurst, Graner, and Grummit soils and from Slickspots in having columnar structure in the B2t horizon.

Dix Series

The Dix series consists of nearly level, somewhat excessively drained loamy soils. These soils are on stream terraces. They formed in sandy alluvium that is underlain by sand and gravel at a depth of less than 20 inches.

In a representative profile the surface layer is about 7 inches thick. It is dark grayish-brown sandy loam in the upper part and brown fine sandy loam in the lower part. Below this is a 7-inch transition layer of brown fine sandy loam that is slightly hard whem dry and very friable when moist. The underlying material is about 3 inches of grayish-brown gravelly clay loam over multicolored gravel and sand. It is calcareous.

Dix soils have medium fertility and low available

water capacity. Permeability is moderately rapid in the subsoil and rapid in the underlying gravel and sand. Runoff is slow.

These soils are used mainly for range. Some areas are cultivated. Alfalfa, corn, and small grain are the main crops. The native vegetation is mainly short and mid grasses, sedges, and pricklypear cactus.

Representative profile of Dix sandy loam, 0 to 3 percent slopes, in crested wheatgrass, 1,700 feet north and 180 feet west of the southeast corner, sec. 14, T. 8 N., R. 4 E.:

Ap1—0 to 2 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very fine, granular structure; soft, very friable; few small pebbles; mildly alkaline; clear, smooth boundary.

Ap2—2 to 7 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure; slightly hard, very friable; mildly alkaline; abrupt, smooth boundary.

AC—7 to 14 inches, brown (10Yr 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure; slightly hard, very friable; mildly alkaline; clear, wavy boundary.

IIC1—14 to 17 inches, grayish-brown (2.5Y 5/2) gravelly clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; about 40 percent gravel; violent effervescence; mildly alkaline; gradual, wavy boundary.

IIC2—17 to 40 inches, multicolored gravel and sand; violent effervescence; mildly alkaline.

Depth to gravelly material ranges from 10 to 20 inches. A few pebbles are on the surface and in the profile about the gravelly material. Depth to free carbonates ranges from 0 to 18 inches, but commonly is more than 10 inches. The A horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. The AC horizon ranges from dark grayish brown to pale brown in hue of 10YR or 2.5Y. It is sandy loam or fine sandy loam and is 12 to 18 percent clay. The IIC1 horizon ranges from gravelly clay loam to gravelly sand, but in places it is nearly clean gravel.

Dix soils are near Altvan and Mawer soils. They are more shallow over gravelly material than those soils. They are deeper over gravel than Schamber soils.

Dix sandy loam, 0 to 3 percent slopes (DsA).—This soil is on terraces along streams. Very gentle undulations commonly occur throughout the irregularly shaped areas, which range from 10 to 80 acres in size.

Included with this soil in mapping are areas of Altvan and Mawer soils. These included soils are less than 5 acres in size and make up less than 20 percent of any given area.

This Dix soil takes in water readily, but it has low available water capacity and is too droughty for dryland cultivation. Cultivated areas are subject to soil blowing.

Some of the acreage is in native grass and is used for range. Other areas are cultivated. Many cultivated areas are irrigated. Alfalfa, corn, and small grain are the main crops under irrigation. Small grain is the main dryfarmed crop. Conservation of moisture is the main concern in management. Shallow to Gravel range site; capability units IVse-1 irrigated and VIs-4 dryland; windbreak group 10.

Epsie Series

The Epsie series consists of shallow, gently sloping to steep, well-drained, saline clayey soils on uplands. These soils formed in material weathered from highly saline shale.

In a representative profile the surface layer is light olive-gray clay about 2 inches thick. The underlying material extends to a depth of 14 inches. It is calcareous, light olive-gray clay in the upper part and calcareous, gray and light olive-gray shaly clay in the lower part. It is very hard when dry and very firm when moist. It contains fragments of shale and many spots of segregated salts. Below a depth of 14 inches is soft shale.

Epsie soils have low fertility and very low available water capacity. Permeability is very slow, and runoff is rapid.

These soils are used entirely for range. The native vegetation is a sparse cover of Nuttall saltbush, greasewood, Montana wheatgrass, and annual saltbush.

Representative profile of Epsie clay in an area of Epsie-Shale land complex, 9 to 45 percent slopes, in native grass, 2,300 feet south and 1,550 feet east of the northwest corner of sec. 21, T. 11 N., R. 2 E.:

A1—0 to 2 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) moist; weak, platy crust parting to moderate, fine, granular structure; hard, firm, very sticky and very plastic; few fine segregations of salts; slight effervescence; mildly alkaline; abrupt, smooth boundary.

C1sa—2 to 7 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) moist; massive; very hard, very firm, very sticky and very plastic; common fragments of shale; many fine segregations of salts; slight effervescence; mildly alkaline; gradual, wavy boundary.

C2sa—7 to 14 inches, gray (5Y 5/1) and light olive-gray (5Y 6/2) shaly clay, dark olive gray (5Y 3/2) and olive gray (5Y 4/2) moist; massive; very hard, very firm, very sticky and very plastic; more than 60 percent partly weathered shale fragments; many fine segregations of salts; slight effervescence; moderately alkaline; gradual, wavy boundary.

C3—14 to 30 inches, gray (5Y 6/1) soft shale, olive gray (5Y 4/2) moist; bedded, thin, platy structure; moderately alkaline.

Depth to bedded shale ranges from 6 to 20 inches. Colors throughout the soil are relatively uniform and are inherited from the parent shale. They range from gray to light brownish gray in hue of 5Y or 2.5Y. Iron-manganese concretions are scattered on the surface in most areas. The soil is silty clay, clay, or shaly clay and ranges from 50 to 60 percent clay. Salinity is low or medium in the A horizon, medium to very high in the C horizon above the shale, and high or very high in the underlying shale.

Epsie soils are near Lismas, Swanboy, and Wasa soils. They are more saline than those soils. They are more shallow over shale than Swanboy and Wasa soils.

Epsie clay, 3 to 25 percent slopes (EpD).—This gently sloping to hilly soil is in irregularly shaped areas that range from 40 to more than 500 acres in size. Areas are dissected by many drainageways and small gullies. Crusts of white salts and many iron-manganese concretions commonly are on the surface.

Included with this soil in mapping are areas of Shale land. These outcrops of shale are on the higher and steeper parts of the landscape and make up less than 15 percent of any given area. The shale is very saline.

This soil has low fertility and is high in content of salts. It takes in water very slowly and has very low available water capacity. Runoff is rapid.

Figure 12.—Sparse vegetation on Epsie-Shale Land complex, 9 to 45 percent slopes.

All the acreage is used for range. The vegetative cover is very sparse. Saline Upland range site; capability unit VIIs-3; windbreak group 10.

Epsie-Shale land complex, 9 to 45 percent slopes (EsE).—This rolling to steep mapping unit is about 75 percent Epsie soils and 25 percent Shale land. Areas range from about 100 to 4,000 acres in size and are dissected by many drainageways and uncrossable gullies. Crusts of white salts and small iron–manganese concretions commonly are scattered on the surface. The Epsie soil has the profile described as representative of the Epsie series. Shale land is on narrow ridges and on the steep sides of eroding drainageways. It consists of outcrops of very saline shale that is unaltered or only slightly altered by weathering.

Included with these soils in mapping are areas of a soil that is similar to Epsie soils but less than 6 inches deep over shale.

These soils take in water very slowly and have very low available water capacity. Runoff is rapid or very rapid, and geologic erosion is active.

All the acreage is used for range. The vegetative cover is very sparse and consists mainly of salt-tolerant plants (fig. 12). Areas of Shale land are bare or nearly bare of vegetation. Epsie soil in Saline Upland range site, capability unit VIIs-3, and windbreak group 10; Shale land in capability unit VIIIs-2 and not assigned to a range site or windbreak group.

Glenberg Series

The Glenberg series consists of deep, nearly level to gently sloping, well-drained, calcareous loamy soils. These soils are on bottom land and low terraces. They formed in loamy and sandy alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 6 inches thick. The underlying material to a depth of 35 inches is grayish-brown fine sandy loam that is slightly hard when dry and very friable when moist. Below a depth of 35 inches is light brownish-gray loamy sand. The entire profile is calcareous.

Glenberg soils are susceptible to soil blowing. In some areas they are subject to flooding. They have low fertility and moderate available water capacity. Permeability is moderately rapid to a depth of 35 inches and rapid below. Runoff is slow.

Many areas are irrigated. Alfalfa, corn, and edible beans are the main crops. Other areas are in native grass and are used for grazing or hay. The native vegetation is mid and tall grasses and an understory of short grasses. Scattered native trees and shrubs grow along stream channels in many areas.

Representative profile of Glenberg fine sandy loam, 0 to 2 percent slopes, in a cultivated area, 900 feet north and 2,410 feet west of the southeast corner of sec. 22, T. 8 N., R. 6 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, fine, granular structure; slightly hard, very friable; many roots; slight effervescence; neutral; abrupt, smooth boundary.

C1—6 to 35 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; common roots in upper part, few in lower part; strong effervescence; mildly alkaline; clear, wavy boundary.

C2—35 to 60 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grained; loose, very friable; strong effervescence; mildly alkaline.

Depth to free carbonates is less than 10 inches. The A horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. In places it is darker colored in the upper 1 to 5 inches. It commonly is fine sandy loam, but ranges from sandy loam to clay. The C horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is fine sandy loam that is less than 18 percent clay and more than 15 percent sand coarser than very fine sand. The profile commonly is stratified with material ranging from loamy fine sand to silt loam, and in places it contains thin lenses of clay.

Glenberg soils are on bottom land along with Haverson and Lohmiller soils. They are more sandy than those soils.

Glenberg fine sandy loam, 0 to 2 percent slopes (GgA).—This soil is on low terraces along the Belle Fourche River. It has the profile described as representative of the series. Areas are irregular in shape and range from 5 to 300 acres in size.

Included with this soil in mapping are areas of Haverson, Lohmiller, and Mawer soils. Haverson and Lohmiller soils are in small areas where the alluvium is more clayey. Mawer soils are in areas less than 2 acres in size where pockets of gravel are within a depth of 40 inches.

This Glenberg soil takes in water readily and has moderate available water capacity. Fertility is low. Soil blowing is a hazard in cultivated areas.

Many areas are irrigated. Corn, alfalfa, barley, and edible beans are the main crops. Controlling soil blowing is the main concern in management. Sandy range site; capability units IIe-3 irrigated and IVe-6 dryland; windbreak group 2.

Glenberg fine sandy loam, 2 to 6 percent slopes (GgB).—This soil is on bottom land and low terraces along the Belle Fourche River and its main tributaries. Areas are mostly long and narrow and range from 3 to 25 acres in size.

This soil takes in water readily and has moderate available water capacity. It has low fertility. Runoff is slow, but water erosion and soil blowing are hazards in cultivated areas.

Many areas are irrigated. Alfalfa and corn are the main crops. Other areas are in native grass and are used for grazing. Controlling soil blowing and erosion is the main concern in management. Sandy range site; capability units IIIe-4 irrigated and IVe-7 dryland; windbreak group 2.

Glenberg and Haverson soils (0 to 3 percent slopes) (Gh).—Some areas of this mapping unit are mostly Glenberg soils, some are mainly Haverson soils, and others consist of both soils in proportions that differ from one area to another. Areas are cut by overflow channels and meander scars and consequently have an uneven, very gently undulating surface. The Glenberg soil, commonly on low ridges and mounds, has a profile similar to the one described as representative of the Glenberg series, but in places the surface layer is loamy sand. The Haverson soil, in the smoother areas, has the profile described as representative of the Haverson series. Recently deposited sediment from mining commonly is on the surface in areas adjacent to the channels of Whitewood Creek and the Belle Fourche River below its confluence with Whitewood Creek.

Included with these soils in mapping are areas of Lohmiller soils in some of the meander scars and areas of soils that are more sandy or more gravelly than Glenberg soils.

These soils have low fertility. Available water capacity is moderate or high. Runoff is slow, and most areas are subject to flooding.

Cultivation is impractical in most places because the areas are narrow and are cut by stream channels. Most of the acreage is in native vegetation and is used for range, hay, and wildlife habitat. The native vegetation is tall and mid grasses and scattered native trees and shrubs. Overflow range site; capability unit VIw-3; windbreak group 10.

Graner Series

The Graner series consists of deep, gently undulating to hilly, well-drained, acid clayey soils on uplands. These soils formed in wind-deposited clayey material that contains many fine fragments of shale.

In a representative profile the surface layer is grayish-brown clay about 6 inches thick. The underlying material is grayish-brown clay that is slightly hard when dry and friable when moist. The entire profile contains many fragments of shale and is very strongly acid or extremely acid.

Graner soils have low fertility and low or moderate available water capacity. Permeability is moderate, and runoff is slow. Erosion and soil blowing are hazards.

Most areas are used for range. The native vegetation is mainly mid and tall grasses.

Representative profile of Graner clay, 3 to 25 percent slopes, in native grass, 1,800 feet west and 500 feet north of the southeast corner of sec. 4, T. 9 N., R. 1 E.:

A1—0 to 6 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; weak, very fine, granular structure; soft, friable; many roots; many very fine shale fragments; very strongly acid; clear, smooth boundary.

C1—6 to 20 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) crushing to dark grayish brown (10YR 4/2) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable; common roots; many very fine shale fragments; very strongly acid; gradual boundary.

C2—20 to 60 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) crushing to dark grayish brown (10YR 4/2) moist; very weak, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard, friable; few roots; many very fine shale fragments; extremely acid.

Colors of the soil are inherited from the parent material.

Figure 13.—**Blowout in Graner clay, 3 to 25 percent slopes.**

The entire profile is clay and ranges from 60 to 70 percent clay. The soil ranges from strongly acid to extremely acid. The A1 horizon ranges from dark gray to light brownish gray in hue of 10YR or 2.5Y and contains less than 1 percent more organic matter than the C horizon. The A1 horizon contains common to many very fine fragments of partly weathered shale. The C horizon ranges from grayish brown to light olive gray in hues of 10YR to 5Y. It is more than 50 percent very fine fragments of partly weathered shale.

Graner soils are near Broadhurst, Demar, and Grummit soils. They are more friable than Broadhurst soils. They do not have the columnar structure that is characteristic of Demar soils. They are deeper over shale than Grummit soils.

Graner clay, 3 to 25 percent slopes (GnC).—This gently undulating to hilly soil is on uplands. Areas are irregular in shape and range from 40 to several hundred acres in size.

Included with this soil in mapping are areas of Grummit soils on the shoulders of drainageways and on the higher parts of the landscape. Also included in some areas, commonly near the Grummit soil, are areas of a soil that is similar to this Graner soil, but the underlying shale is at depths between 20 and 40 inches.

This soil takes in water readily and has low or moderate available water capacity. It blows easily, and areas of active soil blowing are common (fig. 13). The soil also is susceptible to erosion, and small gullies are common in sloping to moderately steep areas.

All the acreage is in native vegetation and is used for range. Controlling soil blowing and erosion is the main concern in management. Porous Clay range site; capability unit VIe-4; windbreak group 10.

Grummit Series

The Grummit series consists of shallow, gently sloping to steep, well-drained, acid clayey soils on uplands. These soils formed in very fine clay and shale particles weathered from the underlying acid shale. In places the soil material has been reworked by wind.

In a representative profile the surface layer is light brownish-gray, very strongly acid clay about 3 inches thick. The underlying material to a depth of 17 inches is grayish-brown, extremely acid clay and shaly clay that contains many fragments of shale. It is soft when dry and friable when moist. Below this is gray shale (fig. 14).

Grummit soils have low fertility and very low available water capacity. Permeability is moderate above the shale, and runoff is medium or rapid. Erosion and soil blowing are severe hazards.

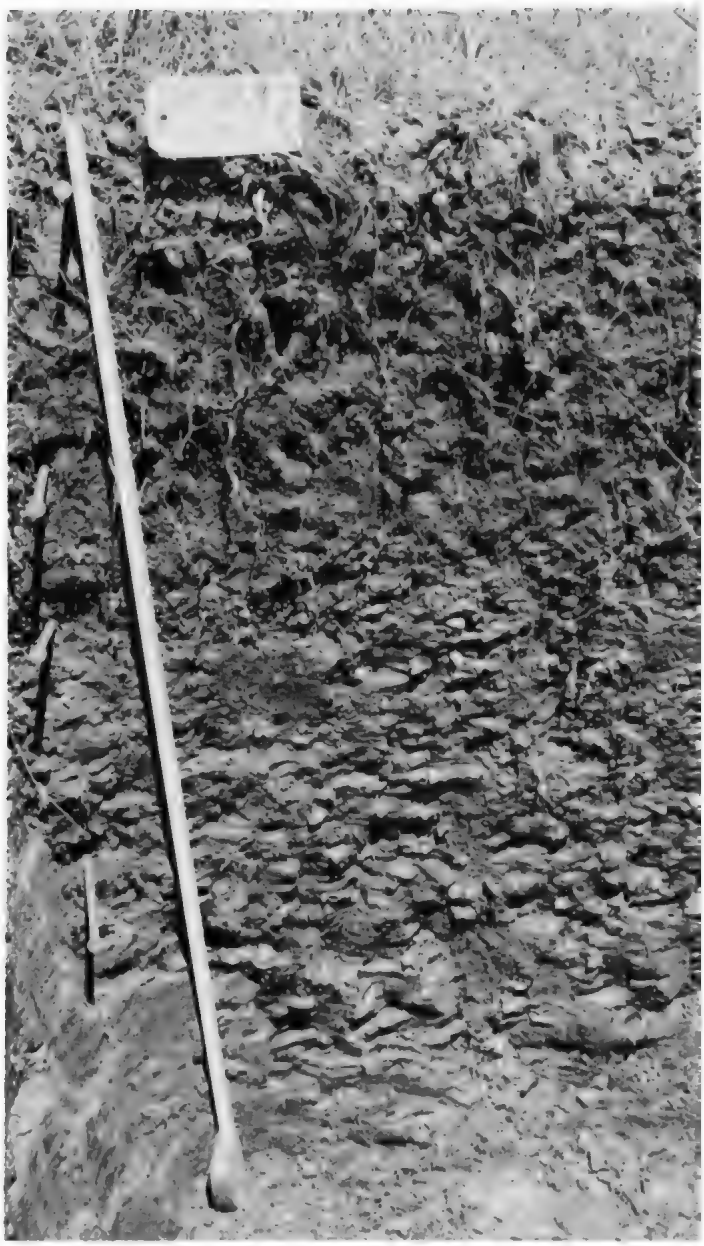

Figure 14.—**Profile of Grummit clay, 3 to 25 percent slopes, showing underlying shale.**

These soils are used for range. The native vegetation is mainly short and mid grasses.

Representative profile of Grummit clay, 3 to 25 percent slopes, in native grass, 200 feet east and 1,800 feet north of the southwest corner of sec. 30, T. 9 N., R. 2 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; loose, friable; many roots; many very fine shale fragments; very strongly acid; clear, smooth boundary.

C1—3 to 7 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; soft, friable; many roots; many very fine shale fragments; extremely acid; gradual boundary.

C2—7 to 17 inches, grayish-brown (10YR 5/2) and gray (2.5Y 5/1) shaly clay, dark grayish brown (10YR 4/2) and dark gray (2.5Y 4/1) moist; weak, coarse, subangular blocky structure; soft, friable; common roots; many very fine, fine, and medium shale fragments; extremely acid; clear, smooth boundary.

C3—17 to 40 inches, gray (10YR 6/1) brittle platy shale, dark gray (10YR 4/1) moist; common, medium, distinct, yellowish-brown (10YR 5/8) stains; very hard; extremely acid.

Depth to shale ranges from about 5 to 20 inches. Colors throughout the profile are inherited from the parent shale. The horizons above the bedded shale range from about 55 to 65 percent clay. Consistence ranges from loose to hard when dry. The soil ranges from strongly acid to extremely acid. The A1 horizon ranges from gray to light brownish gray in hue of 10YR or 2.5Y and contains less than 1 percent more organic matter than the C horizon. The C horizon ranges from gray to light olive gray in hues of 10YR to 5Y. The C1 horizon is 5 to 20 percent weathered shale fragments, and the C2 horizon is 30 to more than 50 percent. The underlying fissile shale is very hard and brittle, but the hardness is less than 3 on the Mohs' scale.

Grummit soils are near Broadhurst, Demar, and Graner soils. They are shallower over bedded shale than those soils. They are more acid than Lismas and Midway soils, which also are shallow over shale.

Grummit clay, 3 to 25 percent slopes (GrE).—This soil is in irregularly shaped areas that range from 10 to several hundred acres in size. Eroding drainageways and small gullies are common. In some areas below high terraces, the upper few inches of the soil is more alkaline and is harder and firmer than in the profile described as representative of the series.

Included with this soil in mapping are areas of Graner soils, commonly on fans in the lower parts of the landscape below Grummit soils.

This soil has low fertility and very low available water capacity. It is susceptible to erosion and soil blowing.

This soil is used for range. It is not suitable for cultivation. Shallow range site; capability unit VIs-2; windbreak group 10.

Hanly Series

The Hanly series consists of deep, nearly level, well-drained sandy soils on bottom land along major streams. These soils formed in sandy alluvium.

In a representative profile the surface layer is grayish-brown loamy fine sand about 5 inches thick. The underlying material to a depth of 34 inches is calcareous, grayish-brown loamy fine sand that is soft when dry and very friable when moist. Below a depth of 34 inches is calcareous, grayish-brown loamy sand.

Hanly soils have low fertility and available water capacity. Permeability is rapid, and runoff is slow. Most areas are subject to stream flooding. Soil blowing is a severe hazard.

All the areas are in native vegetation and are used for range. The native vegetation is mainly mid and tall grasses.

Representative profile of Hanly loamy fine sand, in native grass, 1,900 feet west and 700 feet north of the southeast corner of sec. 23, T. 14 N., R. 6 E.:

A1—0 to 5 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak, very fine, granular structure; soft, very friable; many roots; mildly alkaline; clear, smooth boundary.

C1—5 to 34 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; single grained; soft, very friable; many roots in upper part, few in lower part; slight effervescence; mildly alkaline; clear, smooth boundary.

C2—34 to 60 inches, grayish-brown (2.5Y 5/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose, very friable; slight effervescence; mildly alkaline.

Depth to carbonates is less than 10 inches. The A1 horizon ranges from dark grayish brown to light brownish gray in hue of 2.5Y or 10YR. In places the upper 1 to 3 inches is darker colored. The A1 horizon ranges from loamy fine sand to loam. The C horizon ranges from grayish brown to pale yellow. It averages loamy fine sand or coarser and commonly is stratified with coarser and finer textured material.

Hanly soils are near Assinniboine, Chinook, and Zeona soils. They do not have the B horizon that is characteristic of Assinniboine and Chinook soils, and they contain more sand. They are more stratified and more calcareous than Zeona soils.

Hanly loamy fine sand (0 to 3 percent slopes) (Ha).—This soil is on bottom land. Areas range up to several miles long and from 200 to 1,000 feet wide. The surface commonly is uneven or hummocky.

Included with this soil in mapping are areas of Zeona soils on the outer edges of the areas where they merge into uplands. Also included, in some areas, are Loamy alluvial land and Saline alluvial land. Included soils make up less than 15 percent of any given area.

This Hanly soil takes in water readily, but is droughty. It has low fertility. It is subject to flooding and blows easily.

All the acreage is in native vegetation and is used for range. Controlling soil blowing is the main concern in management. Sands range site; capability unit VIe-8; windbreak group 7.

Haverson Series

The Haverson series consists of deep, nearly level to gently sloping, well-drained, calcareous loamy soils. These soils are on bottom land and low terraces along streams. They formed in alluvium.

In a representative profile the surface layer is about 6 inches thick. The upper part is grayish-brown loam, and the lower part is grayish-brown silt loam. The underlying material to a depth of 14 inches is light brownish-gray loam and silt loam. Below a depth of 14 inches is light brownish-gray stratified loam and silt loam that has thin layers of loamy fine sand. The entire profile is calcareous.

Haverson soils have low fertility and high available water capacity. Permeability is moderate, and runoff is slow or medium. Most areas are seldom flooded. Soil blowing is a severe hazard.

Many areas are used for irrigated crops. Alfalfa, corn, and edible beans are the main irrigated crops. Other areas are in native vegetation. The native vegetation is mid and short grasses and stringers of native trees along stream channels.

Representative profile of Haverson loam in an area of Glenberg and Haverson soils, formerly cultivated and now in grass, 2,100 feet north and 1,235 feet west of the southeast corner of sec. 11, T. 8 N., R. 4 E.:

Ap1—0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, very friable; many roots; slight effervescence; mildly alkaline; clear, smooth boundary.

Ap2—2 to 6 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable; many roots; slight effervescence; mildly alkaline; abrupt, smooth boundary.

C1—6 to 9 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, very friable; common roots; strong effervescence; mildly alkaline; clear, wavy boundary.

C2—9 to 14 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; very weak, coarse, prismatic structure; slightly hard, very friable; common roots; mildly alkaline; gradual, wavy boundary.

C3—14 to 60 inches, light brownish-gray (10YR 6/2) stratified loam and silt loam that has thin lenses of loamy fine sand, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; few roots; strong effervescence; mildly alkaline.

Depth to free carbonates is less than 10 inches. The A horizon commonly ranges from grayish brown to pale brown in hue of 10YR or 2.5Y, but in some areas the upper part is very dark grayish brown or darker when moist. The A horizon commonly is loam, but it ranges from fine sandy loam to silty clay loam or clay loam. The C horizon ranges from very fine sandy loam to light clay loam and is 18 to 35 percent clay. The C horizon commonly is stratified with thin layers of coarser and finer textured material.

Haverson soils are mapped with Glenberg soils and are near Lohmiller soils. They contain more clay than Glenberg soils and less clay than Lohmiller soils.

Haverson loam, 0 to 2 percent slopes (HeA).—This soil is on bottom land and low terraces mainly along the Belle Fourche River. Areas are irregular in shape and range from 5 to 200 acres in size.

Included with this soil in mapping are areas of Glenberg and Lohmiller soils. Also included are small areas of Dix and Mawer soils that have gravel at a depth of less than 40 inches.

This Haverson soil has low fertility. It takes in water readily and has high available water capacity. Runoff is slow. Most areas are seldom flooded.

Many areas are cultivated and are irrigated. The soil is well suited to all crops commonly grown under irrigation in the county. Water management is the main concern in irrigated areas. Conservation of moisture is the main concern in dryland areas. Silty range site; capability units I–3 irrigated and IIIc-2 dryland; windbreak group 1.

Haverson loam, 2 to 6 percent slopes (HeB).—This soil is on bottom land and low terraces along the Belle Fourche River and its main tributaries. Areas commonly are long and narrow and range from 3 to 20 acres in size. Slopes are short and irregular.

This soil has low fertility. It takes in water readily and has high available water capacity. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Many areas are used for irrigated crops. Alfalfa and corn are the main crops. Other areas are in native grass and are used for grazing. Controlling erosion and soil blowing is the main concern in management. Silty range site; capability units IIIe-3 irrigated and IIIe-1 dryland; windbreak group 1.

Hisle Series

The Hisle series consists of moderately deep,

nearly level to sloping, well drained or moderately well drained loamy soils that have a claypan subsoil. These soils are on uplands. They formed in clayey material either washed in from adjacent soils or weathered in place from the underlying shale.

In a representative profile the surface layer is gray loam about 2 inches thick. The subsoil, about 14 inches thick, is grayish-brown clay that is extremely hard when dry and very firm when moist. The underlying material to a depth of 35 inches is grayish-brown clay that contains many spots and streaks of lime and salts. Below a depth of 35 inches is multicolored, bedded shale.

Hisle soils have low fertility and low or very low available water capacity. Permeability is very slow, and runoff is slow to rapid.

These soils are used almost entirely for range. The native vegetation is mainly short and mid grasses, sagebrush, and pricklypear cactus.

Representative profile of Hisle loam, 0 to 9 percent slopes, in native grass, 150 feet south and 1,900 feet east of the northwest corner of sec. 16, T. 8 N., R. 8 E.:

A2—0 to 2 inches, gray (10YR 6/1) loam, dark grayish brown (10YR 4/2) moist; moderate, thin, platy structure parting to weak, very fine, granular; soft, friable; many roots; slightly acid; abrupt, smooth boundary.

B21t—2 to 5 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium and coarse, columnar structure parting to moderate, medium and coarse, blocky; extremely hard, very firm; common roots; gray (10YR 6/1) silt coatings on column tops; thin continuous clay films on vertical and horizontal faces of peds; mildly alkaline; clear, smooth boundary.

B22t—5 to 16 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium and coarse, prismatic structure parting to moderate, medium and coarse, blocky; extremely hard, very firm; thin continuous clay films on vertical and horizontal faces of peds; few roots; moderately alkaline; clear, smooth boundary.

C1casa—16 to 35 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium and coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; very hard, very firm; very few roots; thin patchy clay films; many segregations of lime and salts; strong effervescence; mildly alkaline; abrupt, wavy boundary.

C2—35 to 50 inches, gray (N 5/0), grayish-brown (2.5Y 5/2), and pale-olive (5Y 6/3) platy clay shale; shale is partly weathered in the upper part; mildly alkaline.

Depth to bedded shale ranges from 20 to 40 inches. The A2 horizon ranges from grayish brown to light gray in hue of 10YR or 2.5Y. It commonly is loam, but in places it is silt loam, clay loam, or silty clay loam and ranges from 1 to 3 inches in thickness. The B2t horizon ranges from dark grayish brown to light olive gray in hues of 10YR to 5Y. It is clay or clay loam and ranges from 35 to 60 percent clay. The B2t horizon has weak to strong, columnar and prismatic structure parting to moderate or strong blocky. The columnar structure is not well defined in some places. The B3 and C horizons contain common or many segregations of salt and carbonates. In a few places the underlying shale is calcareous.

Hisle soils are near Arvada, Kyle, Pierre, Swanboy, and Wasa soils and are mapped with Slickspots. They are more shallow over shale than Arvada soils. They have an A2 horizon and a B horizon that has stronger prismatic or columnar structure than Kyle, Pierre, Swanboy, and Wasa soils. They differ from Slickspots in having distinct A2 and B2t horizons and in having segregations of salts deeper in the profile.

Hisle loam, 0 to 9 slopes (HlB).—This soil is in irregularly shaped areas that range from 10 to 500 acres in size. The surface is uneven in places, and scattered low spots or small depressions range to as much as several feet in diameter. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Kyle, Pierre, Swanboy, and Wasa soils. These soils have longer, smoother slopes than this Hisle soil. Also included are areas of Slickspots in small depressions. Included soils make up less than 20 percent of any given area.

This Hisle soil has low fertility. It takes in water very slowly and has low or very low available water capacity. Tilth is very poor in cultivated areas.

Most of the acreage is in native grass and is used for range. The soil is not suitable for cultivation. Thin Claypan range site; capability unit VIs-3; windbreak group 10.

Hisle-Slickspots complex, 0 to 9 percent slopes (HsB).—This mapping unit is about 60 percent Hisle soils and 40 percent Slickspots. The surface is uneven, and small mounds and ridges rise 4 to 6 inches above small depressions that range from 10 to 50 feet in diameter. The Hisle soil is on the mounds and ridges. Slickspots consists of massive clay that commonly has visible salts at or near the surface. It is in the small depressions.

Included with this complex in mapping are small areas of Arvada, Kyle, Pierre, Swanboy, and Wasa soils. Arvada and Swanboy soils are in the lower parts of the landscape on fans and along drainageways. Kyle, Pierre, and Wasa soils are on some of the rises.

This unit has very poor tilth and takes in water very slowly. Runoff ranges from slow to rapid in the Hisle soil and ponds in the small depressions of Slickspots until the water evaporates.

All the acreage is in native vegetation and is used for range. The Slickspots parts are barren or nearly barren of vegetation. Hisle soil in Thin Claypan range site, capability unit VIs-3, and windbreak group 10, Slickspots in capability unit VIIIs-3 and not assigned to a range site or windbreak group.

Keith Series

The Keith series consists of deep, nearly level to sloping, well-drained silty soils. These soils are on terraces and fans. They formed in loess or in deep silty alluvium.

In a representative profile the surface layer is about 6 inches of silt loam that is dark grayish brown in the upper part and brown in the lower part. The subsoil, about 14 inches thick, is brown heavy silt loam in the upper part and grayish-brown silt loam in the lower part. It is slightly hard when dry and friable when moist. The lower part is calcareous. The underlying material is calcareous, light-gray silt loam that contains spots and streaks of soft lime.

Keith soils have medium natural fertility and high available water capacity. Permeability is moderate, and runoff is slow or medium.

Many areas are cultivated. Alfalfa, corn, and edible beans are the main irrigated crops. Alfalfa and small grain are the main dryfarmed crops. Some areas are in native grass and are used for range and hay. The native vegetation is mid and short grasses.

Representative profile of Keith silt loam, 0 to 2 percent slopes, in native grass, 1,340 feet south and 25 feet west of the northeast corner of sec. 32, T. 8 N., R. 1 E.:

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; very weak, fine, granular structure; loose, friable; many roots; neutral; clear, smooth boundary.

A12—2 to 6 inches, brown (10YR 4/3) silt loam, dark brown (10 YR 3/3) moist; weak, fine and medium, subangular blocky structure; slightly hard, friable; many roots; thin patchy clay films; neutral; clear, smooth boundary.

B2t—6 to 13 inches, brown (10YR 5/3) heavy silt loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable; common roots; thin continuous clay films; neutral; clear, wavy boundary.

B3ca—13 to 20 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable; few roots; thin patchy clay films; few fine segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C1ca—20 to 32 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; very weak, medium, subangular blocky structure; hard, friable; few roots; common medium segregations of lime; violent effervescence; mildly alkaline; gradual, wavy boundary.

C2ca—32 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; few fine segregations of lime; violent effervescence; mildly alkaline.

The solum ranges from 15 to 30 inches in thickness. Depth to carbonates ranges from about 10 to 25 inches. The A1 horizon ranges from dark grayish brown to brown. It commonly is silt loam, but in places it is loam or very fine sandy loam. The A1 horizon is 5 to 10 inches thick. The B2t horizon ranges from dark brown to grayish brown. It is silt loam or silty clay loam and is 22 to 35 percent clay. It has weak or moderate, prismatic structure. The B3 and C horizons range from grayish brown to pale yellow in hue of 10YR or 2.5Y. The C horizon ranges from very fine sandy loam to silty clay loam.

Keith soils are near Altvan, Canyon, Colby, Lakoa, Manter, Mawer, Savo, and Vale soils. They are more silty and are deeper over sand and gravel than Altvan soils. They are deeper over bedrock than Canyon soils. They contain less clay in the B horizon than Lakoa soils and do not have the A2 horizon that is characteristic of those soils. They contain less sand than Manter and Mawer soils. They have B and C horizons that have colors of less reddish hues than Vale soils.

Keith silt loam, 0 to 2 percent slopes (KeA).—This soil is on terraces and fans. Areas are irregular in shape and range from 10 to 500 acres in size. This soil has a profile similar to the one described as representative of the series, but in a few places the surface layer and subsoil are thinner and the depth to lime is less than 10 inches.

This soil has medium fertility. Available water capacity is high. The soil takes in water readily, and runoff is slow.

Many areas are cultivated. Small grain and alfalfa are the main dryfarmed crops. Corn, alfalfa, edible beans, and small grain are the main irrigated crops. Other areas are in native grass and are used for range. Conservation of moisture is the main concern in management. Silty range site; capability units I–2 irrigated and IIIc-1 dryfarmed; windbreak group 3.

Keith silt loam, 2 to 6 percent slopes (KeB).—This soil is on fans and terraces. Slopes are long and smooth. Areas are irregular in shape and range from 20 to 200 acres in size. This soil has a profile similar to the one described as representative of the series, but in places the surface layer and subsoil are thinner and the depth to lime is less than 10 inches.

This soil has medium fertility. Available water capacity is high. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Some of the acreage is cultivated. Small grain and alfalfa are the main dryfarmed crops. Corn, alfalfa, and small grain are the main irrigated crops. Other areas are in native grass and are used for range. Controlling erosion is the main concern in management. Silty range site; capability units IIIe-2 irrigated and IIIe-1 dryland; windbreak group 3.

Keith silt loam, 6 to 9 percent slopes (KeC).—This soil is in irregularly shaped areas that range from 10 to 100 acres in size. It has a profile similar to the one described as representative of the series, but in places the surface layer and subsoil are thinner and the depth to lime is less than 10 inches.

Included with this soil in mapping are areas of Colby soils on rounded knolls or on the higher parts of the landscape. Also included in places are areas of a soil that is similar to this Keith soil, but the surface layer is lighter colored.

This soil has medium fertility. Available water capacity is high. Runoff is medium. Cultivated areas erode easily.

Most of the acreage is in native grass and is used for range. Small grain and alfalfa are the main crops in the few cultivated areas. Controlling erosion is the main concern in management. Silty range site; capability unit IVe-1; windbreak group 3.

Kyle Series

The Kyle series consists of deep, level to sloping, well-drained clayey soils on terraces and upland fans. These soils formed in clayey material weathered from neutral or alkaline shale, either in place or washed in from adjacent soils.

In a representative profile the surface layer is about 3 inches of clay that is light brownish gray in the upper part and grayish brown in the lower part. The subsoil, about 17 inches thick, is calcareous, grayish-brown clay that is very hard when dry and very firm when moist. The underlying material is calcareous, grayish-brown clay that contains spots and streaks of soft lime.

Kyle soils have low fertility and low or moderate available water capacity. Permeability is very slow, and runoff is slow or medium.

Some of the areas are cultivated, and others are in native grass and are used for range. Wheat is the main dryfarmed crop, and alfalfa is the main irrigated crop. The native vegetation is mainly mid and short grasses.

Representative profile of Kyle clay, 2 to 6 percent slopes, in native grass, 1,000 feet west and 300 feet north of the southeast corner of sec. 12, T. 11 N., R. 8 E.:

A11—0 to 1 inch, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, fine, granular structure; hard, firm, sticky and plastic; mildly alkaline; abrupt, smooth boundary.

A12—1 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure; very hard, very firm, sticky and plastic; mildly alkaline; clear, smooth boundary.

B2—3 to 12 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium and fine, blocky; very hard, very firm, sticky and plastic; common pressure faces; slight effervescence; moderately alkaline; gradual, wavy boundary.

B3—12 to 20 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, coarse, and medium, blocky structure; very hard, very firm, sticky and plastic; common pressure faces; slight effervescence; moderately alkaline; gradual, wavy boundary.

Cca—20 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, sticky and plastic; common fine and medium segregations of lime; strong effervescence; moderately alkaline.

The solum ranges from 18 to 30 inches in thickness. Unweathered shale is at a depth of 40 to more than 60 inches. Cracks that are ½ inch to 2 inches wide and several feet long and extend downward through the solum are common when the soil is dry. A weak vesicular crust commonly is on the surface. The A and B horizons range from grayish brown to pale olive in hues of 10YR to 5Y. The A1 horizon is neutral or mildly alkaline. The B horizon is about 60 percent clay. The B3 and C horizons in places contain segregations of carbonates and gypsum. The B and C horizons are mildly alkaline or moderately alkaline.

Kyle soils are near Arvada, Hisle, Lismas, Pierre, Swanboy, and Twotop soils. They contain less sodium than Arvada and Hisle soils and do not have the columnar structure in the B horizon that is characteristic of those soils. They are deeper over shale than Lismas and Pierre soils. They have prismatic structure and are not so hard as Swanboy and Twotop soils. They also contain less salts at a depth of less than 20 inches than Swanboy soils.

Kyle clay, 0 to 2 percent slopes (KlA).—This soil is on terraces and fans. Areas are irregular in shape and range from 10 to 350 acres in size. Slopes are mostly nearly level, but some mapped areas include fans where slopes are more than 2 percent.

Included with this soil in mapping are some areas of Pierre soils, mainly on slight rises.

This Kyle soil has poor tilth. It takes in water very slowly. Runoff is slow, and available water capacity is low or moderate. Soil blowing is a hazard in cultivated areas.

Many areas are in native grass and are used for range or hay. Other areas are cultivated, and some of them are irrigated. Wheat is the main dryfarmed crop. Alfalfa is the main irrigated crop, but some corn and small grain also are grown. Improvement of water intake and tilth is the main concern in management. Clayey range site; capability units IIIs-1 irrigated and IVs-3 dryland; windbreak group 4.

Kyle clay, 2 to 6 percent slopes (KlB).—This soil is on terraces and upland fans. Areas range from 10 to 500 acres in size. In many areas slopes are long and uniform and include small areas where slopes are less than 2 percent. This soil has a profile similar to the one described as representative of the series, but on fans near the Redwater River the surface layer is darker colored.

Included with this soil in mapping are areas of Pierre soil. They are in the higher parts of the landscape.

This Kyle soil has poor tilth and takes in water very slowly. Runoff is medium. Erosion and soil blowing are hazards.

Many areas are in native grass and are used for range or hay. Other areas are cultivated, and some of them are irrigated. Wheat is the main dryfarmed crop. Alfalfa is the main irrigated crop. Controlling erosion and soil blowing is the main concern in management. Improvement of water intake and tilth also is important. Clayey range site; capability units IVes-1 irrigated and IVe-3 dryland; windbreak group 4.

Kyle clay, 6 to 9 percent slopes (KlC).—This soil is mainly on terrace escarpments. Slopes are short and irregular. Areas commonly are long and narrow and range from 5 to 50 acres in size. This soil has a profile similar to the one described as representative of the series, but the subsoil commonly is thinner and has less distinct structure than that in the profile described as representative of the series, and in areas near the Redwater River the surface layer is darker colored.

Included with this soil in mapping are areas of Lohmiller and Stetter soils along small drainageways that cut through some of the areas.

This Kyle soil has poor tilth and takes in water very slowly. Runoff is medium, and erosion is a hazard.

Most of the acreage is in native grass and is used for range. Controlling erosion is the main concern in management. Clayey range site; capability unit VIe-4; windbreak group 10.

Kyle clay, terrace (0 to 1 percent slopes) (Kt).—This soil is on flat terraces. Areas are irregular in shape and range from 10 to more than 500 acres in size. This soil has a profile similar to the one described as representative of the series, but in many places the subsoil does not have prismatic structure.

This Kyle soil has poor tilth and is difficult to work. It takes in water very slowly, and runoff is slow. Soil blowing is a hazard in cultivated areas.

Most of the acreage is irrigated and is used for crops or irrigated pasture. Alfalfa is the main crop under irrigation. Improvement of water intake and tilth is the main concern in management. Clayey range site; capability units IIIs-1 irrigated and IVs-3 dryland; windbreak group 4.

Kyle-Pierre clays, 0 to 6 percent slopes (KuB).—This mapping unit is about 50 percent Kyle soils, 30 percent Pierre soils, and 20 percent other soils. The Kyle soil is on foot slopes and fans and in drainage sags in the lower parts of the landscape. The Pierre soil is in the higher parts of the landscape and has more convex slopes than the Kyle soil.

Included with these soils in mapping are small areas of Hisle and Stetter soils. Hisle soils are in slight depressions in some of the fans and drainage

sags. Stetter soils are along some of the drainageways.

These soils have poor tilth and take in water very slowly. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Most of the acreage is in native grass and is used for range. Several large areas are cultivated. Winter wheat is the main crop. Controlling erosion and soil blowing is the main concern in management. Clayey range site; capability unit IVe-3; windbreak group 4.

Lakoa Series

The Lakoa series consists of deep, strongly sloping to steep, well-drained silty soils on uplands. These soils formed under forest vegetation in material weathered from interbedded sandstone and shale.

In a representative profile the surface layer is pale-brown silt loam about 2 inches thick. It is covered with about 1 inch of pine needles and forest duff. The subsurface layer is pale-brown clay loam about 6 inches thick that is very hard when dry and friable when moist. The subsoil is about 23 inches thick. It is brown clay loam in the upper part, strong-brown sandy clay in the middle, and very pale brown sandy loam in the lower part. When moist, the lower part is mottled with reddish yellow. Below a depth of 31 inches is soft sandstone interbedded with thin seams of soft shale. The entire profile is acid.

Lakoa soils have low fertility and available water capacity. Permeability is moderate, and runoff is medium or rapid.

All the acreage is in native vegetation and is used as grazable woodland. The native vegetation is mainly ponderosa pine and an understory of mid grasses and sedges.

Representative profile of Lakoa silt loam in a wooded area of Lakoa-Colby association, 9 to 50 percent slopes, 400 feet west and 250 feet north of the center of sec. 35, T. 8 N., R. 1 E.:

O1—1 inch to 0, pine needles and forest duff.

A2—0 to 2 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure parting to weak, fine, crumb; soft, very friable; common roots; slightly acid; clear, wavy boundary.

B&A—2 to 8 inches, pale-brown (10YR 6/3) clay loam (B), dark brown (7.5YR 4/3) moist, coated with many light brownish-gray (10YR 6/2) patches of bleached sand grains (A), dark grayish brown (10YR 4/2) moist; moderate, fine and very fine, blocky structure; very hard, friable, sticky and plastic; common roots; thin patchy clay films; medium acid; clear, wavy boundary.

B21t—8 to 16 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 5/4) moist; strong, fine and very fine, blocky structure; very hard, firm, sticky and plastic; common roots; thin continuous clay films on vertical faces of peds; few sandstone fragments; medium acid; clear, wavy boundary.

B22t—16 to 20 inches, strong-brown (7.5YR 5/6) sandy clay, strong brown (7.5YR 5/6) moist and has patchy coatings of brown (7.5YR 5/4) moist; moderate, medium, subangular blocky structure; extremely hard, friable, sticky and plastic; common roots; thin continuous clay films on vertical faces of peds and thin patchy clay films on horizontal faces; few sandstone fragments; medium acid; clear, wavy boundary.

B23t—20 to 31 inches, very pale brown (10YR 7/4) sandy loam, strong brown (7.5YR 5/5) crushing to reddish yellow (7.5YR 6/6) moist; common medium mottles of reddish yellow (7.5YR 7/8) moist; moderate, very coarse, subangular blocky structure; hard, very friable; very few roots; thin continuous clay films on vertical faces of peds; medium acid; diffuse, wavy boundary.

C—31 to 40 inches, light brownish-gray (2.5Y 6/2) and light yellowish-brown (2.5Y 6/4) soft sandstone and thin seams of shale, light brownish gray (2.5Y 6/2) moist; many, fine and medium, reddish-yellow (7.5YR 6/8) mottles and few, medium, olive-yellow (2.5Y 6/6) mottles; thin continuous clay films on fracture faces of sandstone; slightly acid.

The solum ranges from 20 to 40 inches in thickness. The upper 10 inches is more than 0.6 percent organic matter. Depth to bedrock ranges from 30 to 40 inches or more. In places a thin A1 horizon has formed. The A2 horizon ranges from light brownish gray to pink in hue of 10YR or 7.5 YR. It is silt loam, loam, or fine sandy loam. Interfingering of A2 material into the B horizon is common. The B2t horizon ranges from reddish brown to yellow in hues of 5YR to 10YR and in places contains thin seams of purple and green material weathered from shale. The upper part is sandy clay or clay loam. Reaction is medium acid or slightly acid throughout the B horizon.

Lakoa soils are mapped with Colby soils and are near Butche, Boneek, Canyon, Keith, and Midway soils. They are deeper over bedrock than Butche, Canyon, and Midway soils. They have a lighter colored A horizon than Boneek and Keith soils. In contrast with Colby soils, they have a B horizon and are deeper over carbonates.

Lakoa-Colby association, 9 to 50 percent slopes (LaF).—This mapping unit is about 50 percent Lakoa soils and 35 percent Colby soils. It is on uplands on the sides of broad ridges that are dissected by many drainageways. The Lakoa soil, on the mid to higher parts of the broad ridges, commonly faces north and west. It has a profile similar to the one described as representative of the Lakoa series, but in places the underlying sandstone is interbedded with limestone and shale. The Colby soil is on the mid and lower parts of the ridges.

Included with these soils in mapping are areas of Butche, Keith, and Midway soils and Rock outcrop. Butche soils, the most extensive, and Rock outcrop are on the higher parts of the landscape. Keith soils are on the lower parts, on fans and benches along drainageways. Midway soils are in places where clay shale is near the surface. Also included are soils that are similar to Colby soils but are noncalcareous.

These soils have low fertility. Runoff is medium or rapid, depending on slope. Erosion is a hazard.

All the acreage is in native vegetation and is used for range. Most of the Lakoa acreage is forested with ponderosa pine. The understory is grass. Capability unit VIIe–1; windbreak group 10; Lakoa soil not assigned to a range site, Colby soil in Thin Upland range site.

Lismas Series

The Lismas series consists of shallow, gently sloping to moderately steep, excessively drained clayey soils on uplands. These soils formed in material weathered from the underlying clay shale.

In a represenative profile the surface layer is grayish-brown clay about 4 inches thick. The underlying material to a depth of 16 inches is light brown-

ish-gray clay and shaly clay. The upper part is extremely hard when dry and very firm when moist. Below a depth of 16 inches is light olive-gray and pale-olive bedded shale.

Lismas soils have low fertility and very low available water capacity. Permeability is very slow, and runoff is rapid or very rapid.

All areas are in native grass and are used for range. The native vegetation is mainly a sparse cover of mid grasses.

Representative profile of Lismas clay, 3 to 25 percent slopes, in native grass, 1,150 feet north and 1,750 feet east of the southwest corner of sec. 8, T. 10 N., R. 6 E.:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, fine and medium, granular and subangular blocky structure; hard, very firm, sticky and plastic; few fine fragments of soft shale; neutral; clear, smooth boundary.

C1—4 to 10 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, fine and medium, subangular blocky and blocky structure; extremely hard, very firm, sticky and plastic; 5 to 10 percent, by volume, altered shale fragments that retain their platy and blocky shape; common streaks of light yellowish brown on shale fragments; neutral; clear, smooth boundary.

C2—10 to 16 inches, light brownish-gray (2.5Y 6/2) shaly clay, dark grayish brown (2.5Y 4/2) moist; weak, medium and fine, blocky structure; very hard, very firm, slightly sticky and slightly plastic; about 30 percent, by volume, fine and medium shale fragments; yellowish-brown coatings on shale fragments; mildly alkaline; clear, irregular boundary.

C3—16 to 30 inches, light olive-gray (5Y 6/2) and pale-olive (5Y 6/3) clay shale; bedded; plates and blocks are hard and brittle when dry; yellowish-brown fine seams and coatings between plates; neutral.

Depth to shale ranges from about 6 to 20 inches. The soil ranges from dark gray to pale olive in hue of 2.5Y or 5Y. The color and any mottling or staining are inherited from the underlying shale. The horizons above the shale range from 55 to 70 percent clay. In places plant roots penetrate the upper few inches of the shale, but roots are mostly in the horizons above the shale. In places the soil is weakly calcareous above the shale. The C1 horizon is very hard or extremely hard, firm or very firm, sticky or very sticky, and plastic or very plastic. The C1 horizon ranges from 5 to 15 percent shale fragments, and the C2 horizon from 10 to 35 percent. The underlying shale ranges from mildly alkaline to medium acid.

In most of the county, this soil is not calcareous in all parts above the shale, which is outside the defined range for the Lismas series. This difference does not alter the usefulness or behavior of the soil.

Lismas soils are mapped with Pierre soils and are near Kyle, Wasa, and Winler soils. They are more shallow over bedded shale than those soils. They contain less salts than Epsie soils, which also are shallow over shale.

Lismas clay, 3 to 25 percent clopes (LcE).—This soil is in areas that range from 10 to more than 1,000 acres in size. The areas are laced with many small drainageways that feed into larger drainageways. Many drainageways are actively eroding. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Pierre, Stetter, Swanboy, Wasa, and Winler soils and Saline-Alkali land and Shale land. Pierre, Wasa, and Winler soils are in the smoother parts of the landscape where slopes are long. Swanboy soils are on foot slopes and fans. Spots of Saline-Alkali land are in sidehill seeps in some areas. Areas of Shale land are in some areas of cut banks and eroding exposures of shale around the heads of drainageways. Included soils make up less than 25 percent of any given area.

This Lismas soil has low fertility, has poor tilth, and takes in water very slowly. Runoff is rapid or very rapid, depending on slope. Erosion is a hazard.

All the acreage is in native grass and is used for range. Shallow Dense Clay range site; capability unit VIs–2; windbreak group 10.

Lismas-Pierre clays, 3 to 18 percent slopes (LeD).—This mapping unit is 50 to 65 percent Lismas soils, 35 percent Pierre soils, and 0 to 15 percent other soils. Lismas soils are on the tops and sides of narrow ridges and the shoulders of small drainageways. Pierre soils are on the broader ridges and on foot slopes in the lower parts of the landscape. Pierre soils commonly are less sloping than Lismas soils. Both soils have profiles similar to the ones described as representative of their respective series, but in places the Pierre soil is less than 20 inches deep over shale.

Included with these soils in mapping are areas of Kyle soils and Shale land. Kyle soils are gently sloping and are mostly in the lower parts of the landscape. Areas of Shale land occur as cut banks or eroding exposures of shale around the heads of drainageways.

These soils have low fertility and poor tilth. Available water capacity is very low or low. Runoff ranges from medium or rapid on the Pierre soil to rapid or very rapid on the Lismas soil. Erosion is a hazard.

These soils are in native grass and are used for range. Capability unit VIs–2; windbreak group 10; Lismas soil in Shallow Dense Clay range site, Pierre soil in Clayey range site.

Loamy Alluvial Land

Loamy alluvial land (0 to 3 percent slopes) (Lm) is on bottom land along streams and drainageways. Areas range to as much as several miles long and from 200 to 500 feet wide. The narrow areas commonly are cut into smaller parcels by meandering channels. The soil material formed in mixed loamy to sandy alluvium that commonly is layered with finer textured and coarser textured material. The surface layer ranges from loam to loamy fine sand and is erratic in pattern.

Runoff is slow. The areas are subject to overflow from stream channels.

Loamy alluvial land is used mainly for range, hay, and wildlife habitat. Stringers of native trees are along the stream channel in some areas. Overflow range site; capability unit VIw–3; windbreak group 10.

Lohmiller Series

The Lohmiller series consists of deep, nearly level to gently sloping, well-drained silty soils. These soils are on bottom land and low terraces. They formed in calcareous alluvium.

In a representative profile the surface layer is grayish-brown silty clay loam about 7 inches thick. The underlying material is calcareous, light brownish-gray and grayish-brown silty clay loam.

Lohmiller soils have low fertility and moderate or high available water capacity. Permeability is slow, and runoff is slow or medium.

These soils are used mainly for irrigated crops. Alfalfa is the main crop, but corn, edible beans, and small grain also are grown. Some areas are in native grass and are used for grazing or hay. The native vegetation is mainly mid and short grasses.

Representative profile of Lohmiller silty clay loam, 0 to 2 percent slopes, in a cultivated area, 2,505 feet south and 270 feet east of the northwest corner of sec. 29, T. 10 N., R. 5 E.:

Ap—0 to 7 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; cloddy parting to weak, fine, granular structure; hard, firm; many roots; neutral; abrupt, smooth boundary.

C1—7 to 12 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; unaltered bedding planes; hard, firm; common roots; strong effervescence; mildly alkaline; gradual, wavy boundary.

C2—12 to 21 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; unaltered bedding planes; hard, firm; few roots; common fine and medium segregations of salt and gypsum; strong effervesvescence; mildly alkaline; gradual, wavy boundary.

C3—21 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; unaltered bedding planes; hard, firm; few roots; common fine and medium segregations of salt and gypsum; slight effervescence; mildly alkaline.

The soil is calcareous within a depth of 10 inches. The soil commonly ranges from grayish brown to pale olive in hues of 10YR to 5Y. In places a thin A horizon less than 5 inches thick has formed. It has moist colors of very dark grayish brown or darker. The A horizon commonly is silty clay loam or silty clay, but in places it is clay loam or clay. The A horizon ranges from 3 to 8 inches in thickness. The C horizon to a depth of 40 inches ranges from 35 to 55 percent clay. Evidence of stratification in the C horizon is in the form of unaltered bedding planes and thin layers of contrasting texture. In places the C horizon below a depth of 30 inches is loamy or sandy material.

Lohmiller soils are on bottom land, as are Glenberg, Haverson, and Stetter soils. They contain more clay than Glenberg and Haverson soils. They commonly contain less clay and are more calcareous than Stetter soils.

Lohmiller silty clay loam, 0 to 2 percent slopes (LnA).—This soil is on bottom land and low terraces along the Belle Fourche River and its tributaries. Areas are irregular in shape and range from 5 to 300 acres in size. This soil has the profile described as representative of the series, but in the vicinity of Fruitdale the underlying material below a depth of 30 inches is more sandy.

Included with this soil in mapping are areas of Glenberg and Haverson soils in areas where the alluvium is less clayey.

This Lohmiller soil takes in water slowly. Available water capacity is moderate or high. Fertility is low, but crops respond well to commercial fertilizer. The soil is high in content of lime and blows easily. Runoff is slow. Some areas receive additional moisture in the form of runoff from adjacent sloping soils.

Many areas are cultivated and irrigated. The soil is well suited to all crops grown under irrigation in the county. Conserving moisture and controlling soil blowing are the main concerns in management. Clayey range site; capability units I–1 irrigated and IIIc–2 dryland; windbreak group 1.

Lohmiller silty clay loam, 2 to 6 percent slopes (LnB).—This soil is on low terraces and bottom land along the Belle Fourche River and its tributaries. Areas are irregular in shape and range from 5 to 30 acres in size.

This soil takes in water slowly. Available water capacity is moderate or high. Runoff is medium. Erosion and soil blowing are hazards.

Many areas are cultivated and irrigated. Alfalfa is the main crop. Controlling erosion and soil blowing is the main concern in management. Clayey range site; capability units IIIe–1 irrigated and IIIe–1 dryland; windbreak group 1.

Lohmiller silty clay loam, saline (0 to 6 percent slopes) (Lo).—This soil is on valley terraces and fans west and south of Arpan. Areas are irregular in shape and range from 10 to 350 acres in size. This soil has a profile similar to the one described as representative of the series, but contains more salts in the underlying material at a shallower depth.

This soil has low fertility and poor tilth. It takes in water slowly. The high salt content limits its use. Runoff is slow or medium, depending on slope.

Most of the acreage is in native vegetation and is used for range. The native vegetation consists mainly of salt-tolerant plants. This soil is too saline for satisfactory use for crops. Saline Upland range site; capability unit VIIs–3; windbreak group 10.

Lohmiller Variant

The Lohmiller variant consists of deep, nearly level, well-drained, acid silty soils on bottom land. These soils formed in alluvium derived mainly from acid shale.

In a representative profile the surface layer is light brownish-gray silty clay loam about 2 inches thick. The underlying material is grayish-brown and light brownish-gray silty clay loam. It is very hard when dry and firm when moist. The profile is acid throughout.

Lohmiller acid variant soils have low fertility and moderate or high available water capacity. Permeability is slow, and runoff is slow. Most areas are subject to flooding.

These soils are in native grass and are used for range and hay. Western wheatgrass is the main grass.

Representative profile of Lohmiller silty clay loam, acid variant, 1,000 feet south and 2,300 feet west of the northeast corner of sec. 32, T. 9 N., R. 2 E.:

A1—0 to 2 inches, light brownish-gray (2.5Y 6/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak, fine, granular structure; soft, firm, sticky and plastic; common roots; medium acid; clear, smooth boundary.

C1—2 to 9 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse, blocky structure; very hard, firm, sticky and

plastic; common roots; medium acid; gradual, smooth boundary.

C2—9 to 16 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, blocky structure; very hard, firm, sticky and plastic; few roots; strongly acid; gradual, smooth boundary.

C3—16 to 29 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; very hard, firm, sticky and plastic; few roots; very strongly acid; gradual boundary.

C4—29 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; few roots; strongly acid.

Soil colors are inherited from acid shale and range from dark gray to light brownish gray in hue of 10YR or 2.5Y. The A and C horizons are silty clay loam or silty clay and range from 35 to 60 percent clay. The C horizon is hard or very hard when dry and firm or friable when moist.

Lohmiller silty clay loam, acid variant, is near Broadhurst, Demar, Graner, and Grummit soils. It differs from Broadhurst soils in having an erratic distribution of organic matter and in being subject to flooding. It does not have the columnar structure that is characteristic of Demar soils. It is less friable than Graner soils and is deeper over shale than Grummit soils. It is more acid than Lohmiller and Stetter soils, both of which are on bottom land.

Lohmiller silty clay loam, acid variant (0 to 3 percent slopes) (Ls).—This soil is on bottom land mainly along Middle Creek. Areas range up to several miles long and from 200 to 1,500 feet wide. The narrow areas commonly are cut into small parcels by meandering channels and are marked by older meander scars.

This soil has low fertility and is distinctly acid in reaction. Runoff is slow, and the areas are subject to flooding from stream overflow.

Areas of this soil are in native grass and are used for range and hay. Overflow range site; capability unit VIw–2; windbreak group 10.

Manter Series

The Manter series consists of deep, nearly level to gently sloping, well-drained loamy soils. These soils are on terraces along the Belle Fourche River. They formed in sandy alluvium.

In a representative profile the surface layer is a grayish-brown fine sandy loam about 10 inches thick. The subsoil, about 25 inches thick, is brown fine sandy loam that is hard when dry and very friable when moist. Below a depth of 28 inches it is calcareous. The underlying material is calcareous fine sandy loam that is brown in the upper part and pale brown in the lower part.

Manter soils have medium fertility and moderate or high available water capacity. Permeability is moderately rapid, and runoff is slow.

Many areas are cultivated. Alfalfa, corn, and edible beans are the main irrigated crops. Small grain is the main dryfarmed crop. Other areas are in native grass and are used for range.

Representative profile of Manter fine sandy loam, 0 to 2 percent slopes, in a cultivated area, 30 feet south and 1,650 feet west of the northeast corner of sec. 22, T. 8 N., R. 5 E.:

Ap—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; cloddy parting to moderate, very fine and fine, granular structure; hard, very friable; many roots; neutral; abrupt, smooth boundary.

B21t—10 to 16 inches, brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to moderate, fine and medium, blocky; hard, very friable; common roots; thin continuous clay films on faces of peds; neutral; clear, smooth boundary.

B22t—16 to 28 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, fine and medium, blocky; hard, very friable; common roots; thin continuous clay films on faces of peds; neutral; clear, smooth boundary.

B3ca—28 to 35 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium and coarse, blocky structure; hard, very friable; few roots; thin patchy clay films on faces of peds; common fine segregations of lime; strong effervescence; mildly alkaline; gradual, smooth boundary.

C1ca—35 to 42 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable; common fine segregations of lime; strong effervescence; mildly alkaline; gradual boundary.

C2—42 to 60 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; hard, very friable; strong effervescence; mildly alkaline.

Depth to carbonates ranges from 20 to 30 inches. The A and B2t horizons are neutral or mildly alkaline, and the B3 and C horizons are mildly alkaline or moderately alkaline. The A horizon ranges from dark gray to brown in hue of 10YR or 7.5YR. It commonly is fine sandy loam or sandy loam, but in places it is loam. The B2t horizon ranges from dark grayish brown to brown in hue of 10YR or 7.5YR. It is fine sandy loam or sandy loam and ranges from 12 to 18 percent clay. The B3 and C horizons range from grayish brown to light brown in hues of 2.5Y to 7.5YR.

Manter soils are near Alice, Altvan, Glenberg, Keith, and Mawer soils. They differ from Alice soils in having more clay in the B2 horizon. They contain more sand in the A and B horizons than Altvan and Keith soils. They have a B horizon, which does not occur in Glenberg soils, and they do not have the erratic distribution of organic matter that is characteristic of those soils. They do not have the gravelly C horizon between depths of 20 and 40 inches that is characteristic of Mawer soils.

Manter fine sandy loam, 0 to 2 percent slopes (MaA).—This soil is on terraces mainly along the Belle Fourche River. Areas are irregular in shape and range from 10 to 200 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Alice, Altvan, and Mawer soils. Alice soils are on slight rises. Altvan and Mawer soils are less than 40 inches deep over gravel.

This Manter soil has medium fertility. It takes in water readily and has moderate or high available water capacity. Runoff is slow. The soil blows easily.

Many areas are cultivated and irrigated. The soil is well suited to all crops commonly grown under irrigation in the county. Controlling soil blowing is the main concern in management. Sandy range site; capability units IIe–1 irrigated and IVe–6 dryland; windbreak group 5.

Manter fine sandy loam, 2 to 6 percent slopes (MaB).—This soil is on stream terraces. Areas are irregular in shape and range from 10 to 80 acres in size.

Included with this soil in mapping are areas of Alice and Mawer soils, mostly in the higher parts of the landscape.

This soil takes in water readily and has moderate

or high available water capacity. Runoff is slow. Erosion and soil blowing are hazards.

Many areas are cultivated and irrigated. Alfalfa and corn are the main irrigated crops. Small grain is the main dryland crop. Controlling soil blowing and erosion is the main concern in management. Sandy range site; capability units IIIe-4 irrigated and IVe-7 dryland; windbreak group 5.

Manvel Series

The Manvel series consists of deep, nearly level to gently sloping, well-drained, calcareous silty soils. These soils are on terraces and fans. They formed in calcareous material derived from chalky shale and limestone.

In a representative profile the surface layer is grayish-brown silty clay loam about 3 inches thick. Below this is a 15-inch transition layer of light-gray silty clay loam that is hard when dry and firm when moist. The underlying material is light-gray silty clay loam. The entire profile is calcareous.

Manvel soils have low fertility and moderate or high available water capacity. Permeability is moderately slow, and runoff is slow or medium. Soil blowing is a hazard.

Most areas are in native vegetation and are used for range. A few areas are cultivated. Alfalfa is the main irrigated crop. Winter wheat and alfalfa are the main dryfarmed crops. The native vegetation is mainly mid and short grasses.

Representative profile of Manvel silty clay loam, 2 to 6 percent slopes, in native grass, 125 feet west and 2,455 feet north of the southeast corner of sec. 30, T. 9 N., R. 3 E.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak, thick, platy structure parting to weak, fine, granular; slightly hard, friable; violent effervescence; moderately alkaline; clear, smooth boundary.

AC—3 to 18 inches, light-gray (5Y 7/1) silty clay loam, grayish brown (2.5Y 5/2) moist; weak, fine and medium, subangular blocky structure; hard, firm; violent effervescence; moderately alkaline; gradual, smooth boundary.

C1—18 to 24 inches, light-gray (5Y 7/1) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm; violent effervescence; moderately alkaline; abrupt, wavy boundary.

C2—24 to 27 inches, light-gray (5Y 7/1) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm; many channery fragments of limestone; violent effervescence; moderately alkaline; abrupt, wavy boundary.

C3—27 to 60 inches, light-gray (5Y 7/1) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm; violent effervescence; moderately alkaline.

Depth to bedrock is more than 40 inches. A few fragments of limestone commonly are on the surface, and in places they are throughout the soil. Estimated calcium carbonate equivalent ranges from 15 to 60 percent between depths of 10 and 40 inches. The A horizon ranges from dark gray to grayish brown in hues of 5Y to 10YR. It is silty clay loam or silt loam, and in places is noncalcareous. It commonly ranges from 3 to 5 inches thick, but in a few places it is slightly thicker. The AC and C horizons range from gray to pale yellow in hue of 2.5Y or 5Y and are 27 to 35 percent clay. The AC horizon is mildly alkaline or moderately alkaline and ranges from 10 to 30 inches in thickness.

Manvel soils are near Minnequa and Penrose soils. They are deeper over bedrock than those soils.

Manvel silty clay loam, 0 to 2 percent slopes (McA).—This soil is on fans and terraces. Areas are irregular in shape and range from 5 to 200 acres in size. This soil has a profile similar to the one described as representative of the series, but in places the surface layer is slightly thicker.

This soil has low fertility. It takes in water slowly and has moderate or high available water capacity. Runoff is slow. Soil blowing is a hazard in cultivated areas.

Some of the acreage is cultivated. Alfalfa is the main irrigated crop. Small grain and alfalfa are the main dryland crops. Other areas are in native grass and are used for range. Controlling soil blowing is the main concern in management. Thin Upland range site; capability units I-1 irrigated and IVe-10 dryland; windbreak group 8.

Manvel silty clay loam, 2 to 6 percent slopes (McB).—This soil is on fans and foot slopes in the uplands. Areas are irregular in shape and range from 10 to 800 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Minnequa and Penrose soils in the higher parts of the landscape. Included soils make up less than 15 percent of any given area.

This Manvel soil has low fertility. It takes in water slowly and has moderate or high available water capacity. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Most of the acreage is in native grass and is used for range. Alfalfa and small grain are the main crops in cultivated areas. Controlling erosion and soil blowing is the main concern in management. Thin Upland range site; capability units IIIe-1 irrigated and IVe-8 dryland; windbreak group 8.

Marsh

Marsh (0 to 3 percent slopes) (Mh) is commonly wet throughout the year. In irrigated parts of the county it is in seeps and low spots where irrigation water collects and remains for prolonged periods. In dryland areas it is mainly in natural lakebeds that are marshy in most years. Slopes are mainly less than 3 percent.

Marsh is used mainly for wildlife habitat. It is of little value for grazing. The vegetation is mainly water-tolerant grasses, sedges, and shrubs. Capability unit VIIIw-1; windbreak group 10; not assigned to a range site.

Mawer Series

The Mawer series consists of nearly level to gently sloping, well-drained loamy soils that are moderately deep—20 to 40 inches—over sand and gravel. These soils are on stream terraces. They formed in alluvium.

In a representative profile the surface layer is brown fine sandy loam about 8 inches thick. The subsoil, about 14 inches thick, is brown fine sandy loam that is hard when dry and very friable when moist. The underlying material is calcareous, light-gray sand and gravel.

Mawer soils have medium fertility and low available water capacity. Permeability is moderately rapid in the soil and rapid in the underlying sand and gravel. Runoff is slow or medium, depending on slope. Soil blowing is a severe hazard.

Many areas are cultivated. Alfalfa, corn, and edible beans are the main irrigated crops. Small grain is the main dryfarmed crop. Other areas are in native grass and are used for range. The native vegetation is a mixture of short, mid, and tall grasses.

Representative profile of Mawer fine sandy loam, 0 to 2 percent slopes, in a cultivated area, 1,500 feet west and 150 feet north of the southeast corner of sec. 20, T. 8 N., R. 7 E.:

Ap1—0 to 4 inches, brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; cloddy parting to weak, fine, granular structure; hard, very friable; many roots; few fine pebbles; slightly acid; abrupt, smooth boundary.

Ap2—4 to 8 inches, brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse and medium, subangular blocky structure; hard, very friable; many roots; few fine pebbles; neutral; clear, smooth boundary.

B2t—8 to 22 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, very coarse, prismatic structure parting to moderate, medium and coarse, blocky; hard, very friable; common roots; thin continuous clay films; few fine pebbles; neutral; abrupt, wavy boundary.

IIC—22 to 60 inches, light-gray (10YR 7/2) sand and gravel, pale brown (10YR 6/3) moist; single grained; loose; slight effervescence; mildly alkaline.

The solum ranges from 16 to 30 inches in thickness. Depth to sand and gravel ranges from 20 to 40 inches, and depth to carbonates ranges from 15 to 25 inches. The A horizon ranges from dark grayish brown to brown in hues of 2.5Y to 7.5YR. It is fine sandy loam or sandy loam and ranges from 7 to 10 inches in thickness. The B2t horizon ranges from dark grayish brown to light brown in hues of 2.5Y to 7.5YR and is 12 to 18 percent clay. It has weak or moderate, prismatic structure that parts readily to blocky or subangular blocky. Thin B3ca and Cca horizons occur in places. The IIC horizon ranges from loose sand and gravel to gravelly loamy fine sand.

Mawer soils are near Altvan, Dix, Keith, and Manter soils. They are more sandy than Altvan soils. They are deeper over sand and gravel than Dix soils. They are shallower over sand and gravel than Keith and Manter soils and contain more sand than Keith soils.

Mawer fine sandy loam, 0 to 2 percent slopes (MlA).—This soil is on terraces along the Belle Fourche River. Areas are irregular in shape and range from 10 to 800 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Manter soils that are more than 40 inches deep over gravel. Manter soils make up as much as 30 percent of any given area.

This Mawer soil has medium fertility. It takes in water readily, but it has low available water capacity and is droughty. Soil blowing is a hazard in cultivated areas. Runoff is slow.

Many areas are cultivated and irrigated. The soil is well suited to all crops commonly grown under irrigation in the county. Controlling soil blowing and conserving moisture are the main concerns in management. Sandy range site; capability units IIe–2 irrigated and IVe–4 dryland; windbreak group 6.

Mawer fine sandy loam, 2 to 6 percent slopes (MlB).—This soil is on terraces along streams. Areas are irregular in shape and range from 10 to 100 acres in size.

Included with this soil in mapping are areas of Alice, Dix, and Manter soils. Alice and Manter soils are more than 40 inches deep over gravel. Dix soils are on small knolls or humps where gravel is at a shallow depth. Included soils make up from 5 to 30 percent of any given area.

This Mawer soil has medium fertility. It takes in water readily, but it has low available water capacity and is droughty. Runoff is slow or medium. Erosion and soil blowing are hazards in cultivated areas.

Some of the acreage is in native grass and is used for range. Other areas are cultivated. Alfalfa and corn are the main irrigated crops. Small grain is the main dryland crop. Controlling erosion and soil blowing is the main concern in management. Sandy range site; capability units IVes–3 irrigated and IVe–5 dryland; windbreak group 6.

McKenzie Series

The McKenzie series consists of deep, level, poorly drained clayey soils. These soils are in closed depressions on uplands. They formed in clayey alluvium washed in from adjacent soils.

In a representative profile the surface layer is gray clay about 3 inches thick. The underlying material is gray clay that is very hard when dry, very firm when moist, and very sticky and plastic when wet. Below a depth of 23 inches it is calcareous and contains spots and streaks of lime and other salts.

McKenzie soils have low fertility and low or moderate available water capacity. Permeability is very slow, and runoff is ponded. In most years water remains on the surface for short periods until it evaporates.

Most areas are in native grass and are used for range or hay.

Representative profile of McKenzie clay, in grass, 1,950 feet south and 1,500 feet west of the northeast corner of sec. 23, T. 12 N., R. 6 E.:

A1—0 to 3 inches, gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; weak, thin, platy structure; very hard, very firm, very sticky and plastic; slightly acid; clear, smooth boundary.

C1—3 to 9 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; weak, fine, blocky structure; very hard, very firm, very sticky and plastic; slightly acid; gradual, wavy boundary.

C2—9 to 23 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; massive; very hard, very firm, very sticky and plastic; moderately alkaline; gradual, wavy boundary.

C3ca—23 to 60 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; massive; very hard, very firm, very sticky and plastic; common, fine, distinct segregations of lime and salt; slight effervescence; moderately alkaline.

Depth to bedded shale is more than 40 inches. McKenzie soils are saturated with water for 30 days or more in most years. The A horizon ranges from dark gray to light olive gray in hues of 10YR to 5Y. It commonly is clay, but some areas have an overwash of coarser textured material. It is slightly acid or neutral and ranges from 1 to 4 inches in

thickness. The C horizon ranges from gray to light olive gray in hue of 2.5Y or 5Y. It is clay or silty clay and ranges from 50 to 60 percent clay. It is very hard or extremely hard when dry. In some places the C horizon is calcareous throughout. The upper part of the C horizon ranges from slightly acid to moderately alkaline, and the lower part is mildly alkaline or moderately alkaline.

In much of the county, this soil is a few degrees warmer than is defined in the range for the McKenzie series. This difference does not alter the usefulness or behavior of the soils.

McKenzie soils are near Kyle, Pierre, Swanboy, Twotop, Wasa, and Winler soils. They are more poorly drained than those soils.

McKenzie clay (0 to 1 percent slopes) (Mn).—This soil is in small depressions on uplands. Areas are mostly less than 30 acres in size.

Included with this soil in mapping are areas of Kyle, Swanboy, and Twotop soils on small mounds within depressions or on the outer edges of the depressions. Also included in a few areas are soils that have columnar structure in the subsoil. Included soils make up less than 10 percent of any given area.

This McKenzie soil has poor tilth and takes in water very slowly. Runoff is ponded. Water accumulates in wet seasons and remains until it evaporates.

All the acreage is in native grass and is used for range or hay. Closed Depression range site; capability unit VIs–3; windbreak group 10.

Midway Series

The Midway series consists of shallow, gently sloping to moderately steep, well-drained, calcareous silty soils on uplands. These soils formed in material weathered from silty to clayey shale.

In a representative profile the surface layer is light brownish-gray silty clay loam about 4 inches thick. The underlying material to a depth of 13 inches is grayish-brown silty clay loam that is hard when dry and firm when moist. It contains fragments of shale and a few spots of segregated salts. Below a depth of 13 inches is light-gray, platy shale. The soils above the shale and the upper part of the shale are calcareous.

Midway soils have low fertility and very low available water capacity. Permeability is slow, and runoff is medium or rapid.

Most areas are in native grass and are used for range. The native vegetation is mainly short and mid grasses, sagebrush, and pricklypear cactus.

Representative profile of Midway silty clay loam in an area of Midway-Razor silty clay loams, 3 to 15 percent slopes, formerly cultivated and now in grass, 150 feet west and 30 feet north of the southeast corner of sec. 7, T. 10 N., R. 4 E.:

A11—0 to 1 inch, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; crust parting to moderate, fine, granular structure; slightly hard, friable; common roots; slight effervescence; mildly alkaline; clear, smooth boundary.

A12—1 to 4 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, fine and medium, subangular blocky structure; hard, firm; common roots; slight effervescence; mildly alkaline; gradual, smooth boundary.

C1—4 to 8 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, fine and medium, subangular blocky structure; hard, firm; common roots; few fine segregations of salts; strong effervescence; mildly alkaline; clear, smooth boundary.

C2—8 to 13 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, fine and medium, subangular blocky structure; hard, firm; few roots; common shale fragments; few fine segregations of salts; strong effervescence; moderately alkaline; abrupt, wavy boundary.

C3—13 to 22 inches, light-gray (5Y 6/1) platy shale, dark gray (5Y 4/1) moist; very hard; few roots; slight effervescence; moderately alkaline; abrupt, wavy boundary.

C4—22 to 40 inches, light-gray (5Y 6/1) platy shale, dark gray (5Y 4/1) moist; hard; mildly alkaline.

Depth to shale ranges from about 6 to 20 inches. The A horizon ranges from grayish brown to pale olive in hue of 2.5Y or 5Y. It commonly is silty clay loam, but ranges from silt loam to silty clay. The upper 1 inch to 3 inches is noncalcareous in places. The A horizon ranges from 1 inch to 5 inches in thickness. The C horizon above the shale ranges from gray to pale olive in hue of 2.5Y or 5Y. It is silty clay loam or silty clay and ranges from 35 to 45 percent clay. The underlying shale is calcareous or noncalcareous.

Midway soils are mapped with Razor soils; they are near Baca soils; and they are shallow over shale, as are Epsie, Lismas, and Penrose soils. They are more shallow over shale than Baca and Razor soils. They contain less salts than Epsie soils. They are less clayey and more calcareous than Lismas soils. They are more clayey and less calcareous than Penrose soils.

Midway silty clay loam, 6 to 25 percent slopes (MoE).—This soil is on uplands. Areas are irregular in shape and range from 20 to 200 acres in size.

Included with this soil in mapping are areas of Razor soils. They are less steep and are on flattened ridges and in the lower parts of the landscape. Also included in some of the steeper and higher parts of the landscape are outcrops of shale. Included soils make up less than 20 percent of any given area.

This Midway soil has low fertility. It takes in water slowly, has very low available water capacity, and is droughty. Runoff is medium or rapid. Erosion is a hazard.

All the acreage is in native vegetation and is used for range. Controlling erosion is the main concern in management. Shallow range site; capability unit VIs-2; windbreak group 10.

Midway-Razor silty clay loams, 3 to 15 percent slopes (MrD).—This mapping unit is about 50 percent Midway soils, 30 percent Razor soils, and 20 percent other soils. It is on uplands. Areas range from 10 to more than 1,000 acres in size. Midway soils are on the tops and upper sides of ridges and on sharp shoulders of drainageways. Razor soils are mainly gently sloping and are in the lower parts of the landscape. These soils have the profiles described as representative of their respective series.

Included with these soils in mapping are areas of Baca and Hisle soils and clayey and silty alluvial soils. Baca soils are on foot slopes and fans in the lower parts of the landscape. Hisle soils are in drainage sags and along drainageways. The alluvial soils are along some of the larger drainageways.

These soils have low fertility. They take in water slowly, have very low or low available water capacity, and are droughty. Runoff is medium or rapid, depending on slope. Erosion is a hazard.

Most of the acreage is in native vegetation and is used for range. Controlling erosion is the main concern in management. Midway soil in Shallow range site, capability unit VIs-2, and windbreak group 10; Razor soil in Clayey range site, capability unit IVe–3, and windbreak group 4.

Minatare Series

The Minatare series consists of deep, nearly level, somewhat poorly drained soils that have a claypan. These soils are in slight depressions on terraces. They formed in loamy alluvium underlain by gravelly loamy sand.

In a representative profile the surface layer is grayish-brown fine sandy loam about 2 inches thick. The subsoil is about 13 inches thick. It is calcareous, brown clay loam in the upper part and calcareous, light yellowish-brown fine sandy loam in the lower part. The upper part is very hard when dry and friable when moist. The underlying material to a depth of 40 inches is calcareous, yellowish-brown fine sandy loam and sandy clay loam. Below a depth of 40 inches is gravelly loamy sand.

Minatare soils have low fertility and low or moderate available water capacity. Permeability is very slow, and runoff is slow. These soils commonly are wet during part of the growing season because the water table fluctuates.

These soils are used for range. The native vegetation is short and mid grasses and pricklypear cactus.

Representative profile of Minatare fine sandy loam in an area of Minatare-Whitelake complex, in native grass, 1,070 feet south and 130 feet east of the northwest corner of sec. 29, T. 8 N., R. 7 E.:

A—0 to 2 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; cloddy parting to very weak, very fine, granular structure; very hard, very friable; few pebbles, 1/4 inch to 2 inches in diameter; mildly alkaline; abrupt, smooth boundary.

B2t—2 to 6 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, very coarse, columnar structure parting to weak, medium, blocky; very hard, friable; column tops are coated with gray fines; thin patchy clay films and clay bridging of sand grains; slight effervescence; moderately alkaline; clear, smooth boundary.

B31—6 to 11 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4 moist; weak, very coarse, prismatic structure; very hard, very friable; thin patchy clay films and clay bridging of sand grains; strong effervescence; moderately alkaline; gradual, smooth boundary.

B32–11 to 15 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; very weak, very coarse, prismatic structure; hard, very friable; strong effervescence; moderately alkaline; gradual, smooth boundary.

C1—15 to 21 inches, yellowish-brown (10YR 5/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline; gradual, smooth boundary.

C2—21 to 24 inches, yellowish-brown (10YR 5/4) sandy clay loam, yellowish brown (10YR 5/6) moist; massive; hard, friable; strong effervescence; moderately alkaline; gradual, smooth boundary.

C3ca—24 to 40 inches, yellowish-brown (10YR 5/4) sandy clay loam, yellowish brown (10 YR 5/8) moist; common mottles of strong brown (7.5YR 5/6); massive; hard, friable; many coarse segregations of lime; strong effervescence; moderately alkaline; abrupt, smooth boundary.

IIC4—40 to 60 inches, multicolored gravelly loamy sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 10 to 20 inches in thickness. In many places gravel fragments 1/4 inch to 3 inches in diameter are on the surface and in the matrix above the gravelly IIC horizon. The A2 horizon ranges from dark grayish brown to pale brown. It commonly is fine sandy loam, but ranges from loamy fine sand to loam. It ranges from 1 to 3 inches in thickness. The B2t horizon ranges from grayish brown to light yellowish brown. It is clay loam, sandy clay, or clay and ranges from 35 to 45 percent clay. It has moderate or strong, coarse or very coarse, columnar structure parting to weak or moderate, medium, blocky. It ranges from moderately alkaline to very strongly alkaline. Electrical conductivity ranges from 2 to 6 millimhos. The B2t horizon ranges from 4 to 6 inches in thickness. The B3 and C horizons range from brown to brownish-yellow sandy loam to clay loam. They range from moderately alkaline to very strongly alkaline. Electrical conductivity ranges from 8 to 27 millimhos. The gravelly IIC horizon is at a depth of more than 40 inches.

In Butte County, the B2t and B3 horizons of Minatare soils are coarser textured than is defined in the range of the series. This difference does not alter the usefulness or behavior of the soils.

Minatare soils are mapped with Whitelake soils and are near Manter and Mawer soils. They have a thinner A horizon and contain more clay in the B2t horizon than Whitelake soils. They contain more sodium and have a more clayey B2t horizon than Manter and Mawer soils.

Minatare-Whitelake complex (0 to 3 percent slopes) (Ms).—This mapping unit is about 60 percent Minatare soils and 40 percent Whitelake soils. Areas of these soils that have a claypan are mostly on terraces along the Belle Fourche River. Surface relief is made uneven by many small mounds or ridges that rise a few inches above the intervening low spots or depressions. Minatare soils are in the low spots, and Whitelake soils are on the mounds. These soils have the profiles described as representative of their respective series, but in a few areas gravelly material is at depths between 30 and 40 inches.

These soils take in water slowly. The Minatare soil has very poor tilth. Runoff is slow and ponds in the small low spots during wet years. A fluctuating water table rises into the profile in most years and contributes to accumulations of salts. Soil blowing is a hazard in cultivated areas.

Most of the acreage is in native grass and is used for range. Whitelake soils are suitable for cultivation, but the soil pattern in most areas makes cultivation unsatisfactory. Minatare soil in Saline Lowland range site, capability unit VIs–3, and windbreak group 10; Whitelake soil in Sandy range site, capability unit IVe–12, and windbreak group 5.

Mine Pits and Dumps

Mine pits and dumps (Mt) consists of mine pits and dumps or spoil banks of waste material from strip-mining operations. Slopes are short, sharp, and irregular. The areas range from 3 to more than 640 acres in size.

Runoff is rapid on the dumps and ponded in the pits. Some of the pits have water in them during part or all of the year.

Most areas of Mine pits and dumps are barren of

vegetation and have little or no value for grazing. Capability unit VIIIs–2; windbreak group 10; not assigned to a range site.

Minnequa Series

The Minnequa series consists of moderately deep, gently sloping to sloping, well-drained, calcareous silty soils on uplands. These soils formed in material weathered from the underlying chalky shale and limestone.

In a representative profile the surface layer is light brownish-gray silty clay loam about 3 inches thick. Below this is a 4-inch transition layer of light brownish-gray silty clay loam that is hard when dry and firm when moist. The underlying material to a depth of 24 inches is light-gray silty clay loam. The lower part contains many chips of weathered shale. Below a depth of 24 inches is light-gray bedded shale. The entire profile is calcareous.

Minnequa soils have low fertility and available water capacity. Permeability is moderately slow, and runoff is medium. The high lime content of these soils makes them very susceptible to soil blowing.

These soils are used mainly for range. A few areas are cultivated. Alfalfa is the main irrigated crop. Winter wheat and alfalfa are the main dryfarmed crops. The native vegetation is mainly short and mid grasses and sagebrush.

Representative profile of Minnequa silty clay loam in an area of Penrose-Minnequa silty clay loams, 3 to 15 percent slopes, in native grass, 2,000 feet west and 2,500 feet north of the southeast corner of sec. 22, T. 9 N., R. 2 E.:

A1—0 to 3 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, thick, platy structure parting to weak, fine, granular; soft, friable; violent effervescence; moderately alkaline: clear, smooth boundary.

AC—3 to 7 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak, medium and fine, subangular blocky structure; hard, firm; violent effervescence; moderately alkaline; gradual, wavy boundary.

C1—7 to 17 inches, light-gray (5Y 7/1) silty clay loam, light brownish gray (2.5Y 6/2) moist; weak, fine, subangular blocky structure; hard, firm; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2—17 to 24 inches, light-gray (5Y 7/1) silty clay loam, light brownish gray (2.5Y 6/2) moist; massive, horizontal bedding planes of the underlying shale; many fine chips of shale; strong effervescence; slightly hard, firm; moderately alkaline; gradual, wavy boundary.

C3—24 to 50 inches, light-gray (5Y 7/1) platy shale, light brownish gray (2.5Y 6/2) moist; bedded; very hard, firm; violent effervescence; moderately alkaline.

Depth to bedrock ranges from about 20 to 40 inches. In most places the soil is calcareous to the surface. but in some the upper 2 to 4 inches is noncalcareous. The A1 horizon ranges from grayish brown to pale brown in hue of 2.5Y or 10YR. It is silty clay loam or silt loam and ranges from 3 to 5 inches in thickness. The AC and C horizons range from gray to pale olive in hue of 2.5Y or 5Y. They are silty clay loam or silt loam and range from 25 to 35 percent clay. They are hard or very hard when dry and firm or friable when moist. They are mildly alkaline or moderately alkaline. The horizons immediately above the shale commonly contain segregations of salt, mainly gypsum. The estimated calcium carbonate equivalent ranges from 15 to 60 percent. The bedrock is chalky shale interbedded with thin layers of brittle limestone.

Minnequa soils are mapped with Penrose soils, are near Manvel soils, and are similar to Pierre and Razor soils in depth to bedrock. They are deeper over bedrock than Penrose soils and shallower over bedrock than Manvel soils. They contain less clay and are more calcareous than Pierre and Razor soils.

Minnequa silty clay loam, 2 to 6 percent slopes (MuB).—This soil is on uplands. Areas are irregular in shape and range from 5 to 200 acres in size.

Included with this soil in mapping are areas of Manvel and Penrose soils. Manvel soils are on foot slopes and fans. Penrose soils are on the upper parts of ridges.

This Minnequa soil has low fertility. It takes in water slowly and has low available water capacity. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Many areas are in native grass and are used for range. Other areas are cultivated. Alfalfa is the main irrigated crop. Winter wheat, alfalfa, oats, and barley are grown in dryfarmed areas. Controlling erosion and soil blowing is the main concern in management. Thin Upland range site; capability units IVes–2 irrigated and IVe–8 dryland; windbreak group 8.

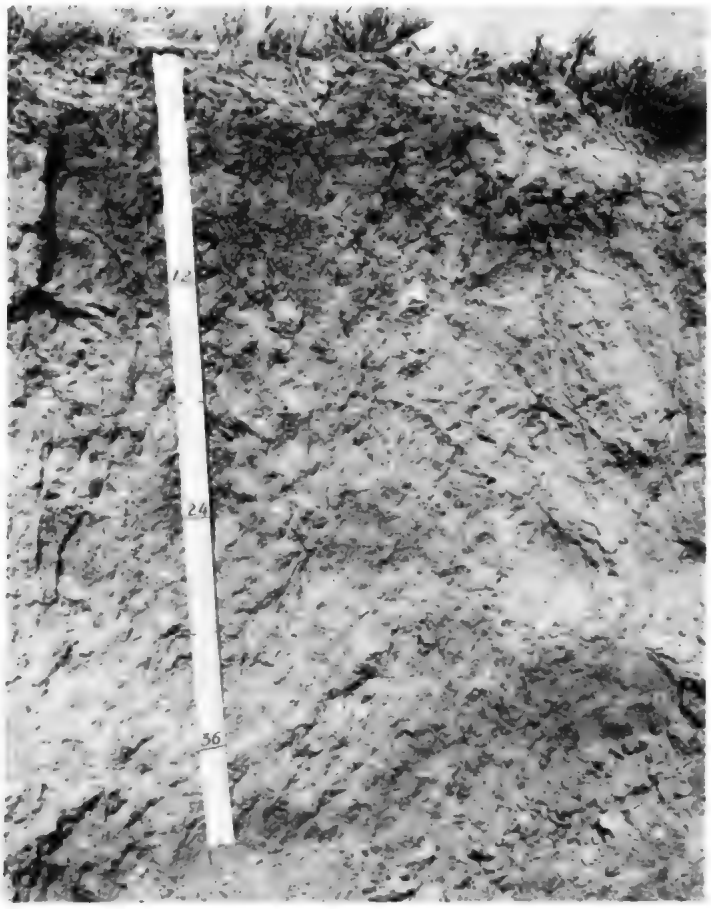

Figure 15.—Profile of Nevee silt loam.

Minnequa silty clay loam, 6 to 9 percent slopes (MuC).—This soil is on uplands. Areas are irregular in shape and range from 10 to 500 acres in size.

Included with this soil in mapping are areas of Penrose soils, mainly in the higher parts of the landscape on the tops and upper sides of ridges.

This Minnequa soil has low fertility and available water capacity. Runoff is medium. Erosion and soil blowing are hazards.

Most of the acreage is in native grass and is used for range. Winter wheat is the main crop in the few cultivated areas. Controlling erosion and soil blowing is the main concern in management. Thin Upland range site; capability unit VIe–3; windbreak group 10.

Nevee Series

The Nevee series consists of deep, gently sloping to hilly, well-drained silty soils on uplands. These soils formed in material derived from reddish-colored, calcareous siltstone and silty shale.

In a representative profile (fig. 15) the surface layer, about 8 inches thick, is silt loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material to a depth of 48 inches is calcareous, reddish-yellow silt loam. The upper part is slightly hard when dry and very friable when moist and contains spots and streaks of soft lime. The lower part contains fragments of siltstone. Below a depth of 48 inches is calcareous, reddish-brown siltstone.

Nevee soils have low fertility and moderate or high available water capacity. Permeability is moderate, and runoff is medium or rapid.

Most areas in native grass are used for range. A few areas are cultivated. Winter wheat and alfalfa are the main crops. The native vegetation is mainly mid and short grasses.

Representative profile of Nevee silt loam in an area of Nevee-Spearfish silt loams, 6 to 25 percent slopes, in native grass, 1,100 feet north and 20 feet east of the southwest corner of sec. 4, T. 7 N., R. 1 E.:

A11—0 to 4 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; soft, very friable; many roots; neutral; clear, smooth boundary.

A12—4 to 8 inches, yellowish-red (5YR 4/6) silt loam, dark reddish brown (2.5YR 3/4) moist; very weak, medium, subangular blocky structure; soft, very friable; many roots; neutral; clear, smooth boundary.

C1ca—8 to 24 inches, reddish-yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; common roots; many fine segregations of lime; violent effervescence; mildly alkaline; gradual, smooth boundary.

C2—24 to 39 inches, reddish-yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; massive; hard, friable; few roots; strong effervescence; mildly alkaline; gradual, smooth boundary.

C3—39 to 48 inches, reddish-yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; massive; hard, very friable; many coarse fragments of siltstone; strong effervescence; mildly alkaline; gradual, smooth boundary.

C4—48 to 60 inches, reddish-brown (2.5YR 4/4) siltstone, dark red (2.5YR 3/6) moist; extremely hard, very friable; strong effervescence; mildly alkaline.

Depth to silty shale, siltstone, or sandstone is more than 40 inches. Depth to free carbonates is less than 10 inches. The A1 horizon ranges from reddish brown to light brownish gray in hues of 5YR to 10YR. It commonly is silt loam, but in places it is loam or very fine sandy loam. The A horizon ranges from 4 to 10 inches in thickness. The C horizon ranges from red to pink in hues of 2.5YR to 7.5YR. It is silt loam, loam, or very fine sandy loam that ranges from 10 to 18 percent clay and is less than 15 percent coarser than very find sand. The C1ca horizon contains few to many, fine or medium segregations of lime.

Nevee soils are mapped with Spearfish soils and are near Barnum, Canyon, Colby, Keith, and Vale soils. They do not have the erratic distribution of organic matter that is characteristic of Barnum soils, and they contain less clay and are more silty. They are deeper over bedrock than Canyon and Spearfish soils. They have colors in redder hues than Colby soils. They do not have the dark-colored A1 and B2t horizons that are characteristic of Keith and Vale soils.

Nevee silt loam, 2 to 6 percent slopes (NeB).—This soil is on uplands. Areas are irregular in shape and range from 10 to 175 acres in size. Slopes are smooth and mainly less than 6 percent, but some areas include slopes of more than 6 percent.

Included with this soil in mapping are areas of a soil that is similar to this Nevee soil, but the surface layer is darker colored and less red.

This soil has low fertility. Available water capacity is moderate or high. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Many areas are in native grass and are used for range. A few areas are cultivated. Alfalfa is the main irrigated crop. Small grain and alfalfa are the main dryfarmed crops. Controlling erosion and soil blowing is the main concern in management. Thin Upland range site; capability units IIIe–3 irrigated and IVe–8 dryland; windbreak group 8.

Nevee-Spearfish silt loams, 6 to 25 percent slopes (NsD).—This mapping unit is about 70 percent Nevee soils and 30 percent Spearfish soils. Areas are irregular in shape and range from 10 to 250 acres in size. Nevee soils are in the mid and lower parts of the landscape and have slopes that are long and smooth. Spearfish soils are more steep and are on the tops and sides of ridges and on the shoulders of drainageways. These soils have the profiles described as representative of their respective series.

Included with these soils in mapping are small areas of Rock outcrop intermingled with Spearfish soils in the higher parts of the landscape. Also included are areas of a soil that is similar to this Nevee soil, but the surface layer is darker colored and less red.

These soils have low fertility. They take in water readily. Runoff is medium or rapid, depending on slope. Erosion is a hazard. Spearfish soils have very low available water capacity and are not suitable for cultivation.

Most of the acreage is in native grass and is used for range. Capability unit VIe–3; windbreak group 10; Nevee soil in Thin Upland range site, Spearfish soil in Shallow range site.

Oburn Series

The Oburn series consists of deep, nearly level to sloping, well-drained loamy soils that have a claypan subsoil. These soils are on terraces and uplands.

They formed in material derived from sandstone, siltstone, and shale.

In a representative profile the surface layer is grayish-brown fine sandy loam about 8 inches thick. Below this is a 2-inch subsurface layer of light brownish-gray fine sandy loam. The subsoil, about 13 inches thick, is clay loam that is brown in the upper part and light brownish gray in the lower part. It is very hard when dry and firm when moist. The lower part is calcareous. The underlying material is calcareous, light brownish-gray sandy clay loam that contains spots and streaks of lime and salts.

Oburn soils have low fertility and moderate available water capacity. Permeability is very slow, and runoff is slow or medium.

Most areas are in native grass and are used for range. The native vegetation is mainly mid and short grasses, sagebrush, and pricklypear cactus.

Representative profile of Oburn fine sandy loam in an area of Absher-Oburn complex, 3 to 9 percent slopes, in native grass, 1,500 feet west and 2,450 feet north of the southeast corner of sec. 17, T. 12 N., R. 8 E.:

A11—0 to 3 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, fine and medium, granular structure; soft, very friable; medium acid; clear, smooth boundary.

A12—3 to 8 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak, medium, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

A2—8 to 10 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, very thin, platy structure; slightly hard, very friable; mildly alkaline; abrupt, wavy boundary.

B21t—10 to 16 inches, brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate, medium and coarse, columnar structure parting to moderate, medium, blocky; very hard, firm; light-gray (2.5Y 7/2) coatings on column tops; thin continuous clay films; neutral; clear, wavy boundary.

B22tca—16 to 23 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium and coarse, blocky; very hard, firm; thin continuous clay films; about 50 percent of faces of peds are coated with lime, few segregations of lime in matrix; violent effervescence; moderately alkaline; gradual, wavy boundary.

C1casa—23 to 28 inches, light brownish-gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure parting to weak, medium and coarse, blocky; very hard, firm; many segregations of lime and salt; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2casa—28 and 60 inches, light brownish-gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm; few fine segregations of lime and salt; violent effervescence; moderately alkaline.

The solum ranges from 16 to 30 inches in thickness. Depth to free carbonates ranges from 9 to 18 inches. The A horizon ranges from dark gray to light yellowish brown in hue of 10 YR or 2.5Y. It commonly is fine sandy loam, but ranges from sandy loam to silt loam. The A1 and A2 horizons range from 6 to 10 inches in combined thickness. The B2t horizon ranges from gray to pale olive in hues of 10YR to 5Y. It is clay loam or clay and ranges from 35 to 50 percent clay. The upper part has moderate or strong, columnar structure and the lower part has weak or moderate, prismatic. These structure forms part to blocks that range from weak to strong. The C horizon ranges from sandy loam to clay in texture and commonly is stratified with finer textured or coarser textured material.

Oburn soils are mapped with Absher and Belfield soils and are near Assinniboine, Ralph, Sorum, and Twilight soils. They have a thicker A horizon than Absher soils. They contain more clay in the B horizon than Archin and Sorum soils. They do not have the B&A horizon that is characteristic of Belfield soils, and they have an A1 horizon that is lighter colored when moist than that of Belfield soils. Their B2t horizon has columnar structure and contains more clay than that of Assinniboine, Ralph, and Twilight soils.

Oburn loam, 0 to 3 percent slopes (ObA).—This soil is on terraces and upland fans. Areas are irregular in shape and range from 10 to 200 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer commonly is loam.

Included with this soil in mapping are areas of Absher and Belfield soils. Absher soils are in slight depressions. Belfield soils are intermingled with Oburn soils. Included soils make up less than 20 percent of any given area.

This Oburn soil has moderate available water capacity, but water penetrates the claypan subsoil very slowly. The claypan limits root development of plants. Runoff is slow. Soil blowing is a hazard in cultivated areas.

Most of the acreage is in native grass and is used for range. Many of the areas formerly cultivated have reverted back to native grass. Improving water intake and conserving moisture are the main concerns in management. Claypan range site; capability unit IVs–2; windbreak group 9.

Parshall Series

The Parshall series consists of deep, nearly level, well-drained loamy soils. These soils are in swales on uplands. They formed in fine sandy loam alluvium.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The subsoil, about 37 inches thick, is fine sandy loam that is dark grayish brown in the upper part and grayish brown in the lower part. The upper part is slightly hard when dry and friable when moist. The underlying material is grayish-brown fine sandy loam.

Parshall soils have medium fertility and moderate or high available water capacity. Permeability is moderate or moderately rapid, and runoff is slow. Soil blowing is a hazard.

Most areas are in native grass and are used for range. Small grains are the main crops in the few cultivated areas. The native vegetation is a mixture of tall, mid, and short grasses.

Representative profile of Parshall fine sandy loam, 0 to 3 percent slopes, in native grass, 1,320 feet south and 660 feet east of the northwest corner of sec. 15, T. 13 N., R. 9 E.:

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable; many roots; slightly acid; clear, smooth boundary.

A12—3 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; moderate, coarse, subangular blocky structure; slightly hard, very friable; many roots; slightly acid; clear, smooth boundary.

B21—6 to 17 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, very coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; slightly hard, friable; common roots; thin patchy clay films on vertical faces of peds; slightly acid; gradual boundary.

B22—17 to 31 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; slightly hard, very friable; common roots; neutral; gradual boundary.

B3—31 to 43 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, prismatic structure; slightly hard, very friable; few roots; neutral; gradual boundary.

C—43 to 60 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, prismatic structure; soft, very friable; neutral.

Depth to free carbonates ranges from 30 to 60 inches or more. The A1 and B2 horizons range from dark grayish brown to brown. They are very dark grayish brown or darker when moist and have a combined thickness of more than 20 inches. The A1 horizon commonly is fine sandy loam, but it is loam in places. The B horizon ranges from 14 to 18 percent clay. In places it contains thin patchy clay films and clay bridgings between sand grains. The B3 and C horizons range from grayish brown to pale brown in hue of 10YR or 2.5Y. Buried horizons occur in places.

Parshall soils are near Assinniboine, Blackhall, Sorum, and Twilight soils. They have thicker horizons that have moist colors of very dark grayish brown or darker than those soils. They contain less clay in the B horizon than Assinniboine and Sorum soils.

Parshall fine sandy loam, 0 to 3 percent slopes (PaA).—This soil is in swales on uplands. Areas commonly are less than 50 acres in size.

Included with this soil in mapping are areas of Assinniboine, Sorum, and Twilight soils. Assinniboine and Twilight soils are on the outer edges of the mapped areas. Sorum soils are intermingled with Parshall soils. Included soils make up less than 15 percent of any given area.

This Parshall soil has medium fertility. It takes in water readily and has moderate or high available water capacity. Runoff is slow. Soil blowing is a severe hazard in cultivated areas.

Most of the acreage is in native grass and is used for range. Small grain and alfalfa are the main crops in the few cultivated areas. Controlling soil blowing is the main concern in management. Sandy range site; capability unit IVe–6; windbreak group 1.

Penrose Series

The Penrose series consists of shallow, gently sloping to moderately steep, well-drained, calcareous silty soils on uplands. These soils formed in material weathered from chalky shale and limestone.

In a representative profile the surface layer is light brownish-gray silty clay loam about 3 inches thick. The underlying material to a depth of 13 inches is light-gray silty clay loam that is slightly hard when dry and firm when moist. It contains many fragments of partly weathered shale. Below a depth of 13 inches is light-gray bedded shale. The entire profile is calcareous.

Penrose soils have low fertility and very low available water capacity. Permeability is moderately slow, and runoff is rapid. Erosion is a severe hazard.

Most areas are used for range. The native vegetation is mainly short and mid grasses.

Representative profile of Penrose silty clay loam in an area of Penrose-Minnequa silty clay loams, 3 to 15 percent slopes, in native grass, 2,060 feet west and 2,500 feet north of the southeast corner of sec. 22, T. 9 N., R. 2 E.:

A1—0 to 3 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak, fine, granular structure; soft, friable; violent effervescence; moderately alkaline; clear, smooth boundary.

C1—3 to 9 inches, light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, firm; many fine fragments of partly weathered shale; violent effervescence; moderately alkaline; clear, smooth boundary.

C2—9 to 13 inches, light-gray (5Y 7/1) silty clay loam, light brownish gray (2.5Y 6/2) moist; massive and has horizontal bedding planes; many fragments of partly weathered shale; slightly hard, firm; violent effervescence; moderately alkaline; gradual, wavy boundary.

C3—13 to 30 inches, light-gray (5Y 7/1) platy shale, light brownish gray (2.5Y 6/2) moist; light yellowish-brown (2.5Y 6/4) and olive-yellow (2.5Y 6/6) stains on fracture faces; violent effervescence; moderately alkaline.

Depth to bedrock ranges from about 8 to 20 inches. The A horizon ranges from gray to light brownish gray in hues of 5Y to 10YR. It is silty clay loam, silt loam, or loam and in places is noncalcareous. The A horizon ranges from 1 to 4 inches in thickness. The C horizon above the bedrock ranges from grayish brown to pale olive in hue of 2.5Y or 5Y. It is silty clay loam or silt loam and ranges from 24 to 35 percent clay. It ranges from slightly hard to very hard when dry and is firm or friable when moist. The C horizon ranges from 15 to 60 percent in estimated calcium carbonate equivalent. It is mildly alkaline or moderately alkaline. Discontinuous ledges of brittle limestone occur in places.

Penrose soils are mapped with Minnequa soils, are near Manvel soils, and are similar to Lismas and Midway soils in depth to shale. They are shallower over bedrock than Minnequa and Manvel soils. They contain less clay and are more calcareous than Lismas and Midway soils.

Penrose silty clay loam, 6 to 25 percent slopes (PeE).—This soil is on uplands. Areas are irregular in shape and range from 20 to 1,000 acres in size. Many contain eroding drainageways and small gullies.

Included with this soil in mapping are areas of Manvel and Minnequa soils and Rock outcrop. Manvel soils are in swales and on fans and foot slopes. Minnequa soils are on the sides of ridges below Penrose soils. Small areas of Rock outcrop are on the upper sides of ridges and around the heads of drainageways. Included soils make up less than 20 percent of any given area.

This Penrose soil has low fertility and very low available water capacity. Runoff is rapid. Erosion is a severe hazard.

Areas of this soil are in native grass and are used for range. Controlling erosion is the main concern in management. Shallow range site; capability unit VIs–1; windbreak group 10.

Penrose-Minnequa silty clay loams, 3 to 15 percent slopes (PmD).—This mapping unit is about 60 percent Penrose soils, 20 percent Minnequa soils, and 20 percent other soils. Areas range from 10 to

several thousand acres in size. Penrose soils are on the tops and sides of ridges and on the shoulders of drainageways. Minnequa soils are mostly gently sloping and are in the mid and lower parts of the landscape below Penrose soils. These soils have the profiles described as representative of their respective series.

Included with these soils in mapping are areas of Hisle and Manvel soils. Manvel soils, the most common inclusion, are on concave foot slopes. Hisle soils are in drainage sags and on some fans and foot slopes. Also included in some areas are alluvial soils on bottom land of the larger drainageways.

These soils have low fertility and are droughty. Runoff is medium or rapid, depending on slope. Erosion is a severe hazard.

Most of the acreage is in native grass and is used for range. Alfalfa and small grain are the main crops in the few cultivated areas. Penrose soil in Shallow range site, capability unit VIs–1, and windbreak group 10; Minnequa soil in Thin Upland range site, capability unit IVe–8, and windbreak group 8.

Pierre Series

The Pierre series consists of moderately deep, nearly level to moderately steep, well-drained clayey soils on uplands. These soils formed in slightly acid to mildly alkaline material derived from clay shale.

In a representative profile the surface layer is grayish-brown clay about 4 inches thick. The subsoil is grayish-brown clay about 21 inches thick that is very hard when dry, very firm when moist, and very sticky and plastic when wet. Below a depth of 8 inches it is calcareous, and below a depth of 18 inches it contains many spots of soft lime. The underlying material to a depth of 28 inches is grayish-brown clay that contains many spots and streaks of lime, gypsum, and other salts. Below a depth of 28 inches is gray shale that is partly weathered in the upper few inches.

Pierre soils have low fertility and low or very low available water capacity. Permeability is very slow, and runoff is slow to rapid, depending on slope.

Most areas are in native grass and are used for range. Wheat is the main dryfarmed crop in the few cultivated areas. A few areas are used for irrigated pasture. The native vegetation is mainly mid and short grasses.

Representative profile of Pierre clay, 2 to 6 percent slopes, in native grass, 1,500 feet each and 650 feet north of the southwest corner of sec. 31, T. 12 N., R. 7 E.:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, fine, granular structure; slightly hard, firm, sticky and plastic; many roots; neutral; clear, smooth boundary.

B21—4 to 8 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, prismatic structure parting to moderate, coarse, blocky; very hard, very firm, very sticky and plastic; common roots; mildly alkaline; clear, wavy boundary.

B22—8 to 18 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, prismatic structure parting to moderate, very coarse and coarse, blocky; very hard, very firm, very sticky and plastic; common roots; common pressure faces; slight effervescence; mildly alkaline; clear, wavy boundary.

B3ca—18 to 25 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, blocky structure; very hard, very firm, very sticky and plastic; few roots; common pressure faces; many coarse segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C1casa—25 to 28 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, very sticky and plastic; few roots; few shale fragments; many segregations of salt, gypsum, and lime; strong effervescence; mildly alkaline; clear, wavy boundary.

C2—28 to 34 inches, gray (5Y 5/1) partly weathered shale, grayish brown (2.5Y 5/2) moist; many, coarse, prominent, yellowish-brown (10YR 5/6) mottles; very hard, very firm, very sticky and plastic; mildly alkaline; gradual, wavy boundary.

C3—34 to 55 inches, gray (5Y 6/1) platy clay shale, dark gray (5Y 4/1) moist; very hard; iron stains on fracture faces; slightly acid.

Depth to bedded shale ranges from 20 to 40 inches. The solum ranges from 15 to 30 inches in thickness and has carbonates up to the surface or is noncalcarious throughout. When the soil is dry, cracks ½ inch to 2 inches wide and several feet long extend downward through the solum. Soil colors range from gray to olive in hue of 2.5Y or 5Y and are inherited from the underlying shale. The A horizon is neutral or mildly alkaline. The B2 horizon is about 60 percent clay. It has weak, coarse or very coarse, prismatic structure parting to moderate, medium to very coarse, blocky. The B horizon is mildly alkaline or moderately alkaline. The underlying shale commonly contains small to moderate amounts of gypsum and other salts in seams. It ranges from slightly acid to mildly alkaline.

Pierre soils are mapped with Kyle and Lismas soils and are similar to Minnequa, Razor, Wasa, and Winler soils in depth to shale. They are deeper over shale than Lismas soils and are more shallow over shale than Kyle soils. They are more clayey and less calcareous than Minnequa and Razor soils. They have prismatic structure and contain less salts than Wasa and Winler soils.

Pierre clay, 0 to 2 percent slopes (PrA).—This soil is on uplands, mainly in the irrigated parts of the county. Areas are irregular in shape and range from 5 to 70 acres in size.

Included with this soil in mapping are areas of Kyle soils, in places where shale is at a depth of more than 40 inches.

This soil has low fertility and poor tilth. It takes in water very slowly and has low or very low available water capacity. Runoff is slow.

Many areas are in native grass and are used for range. Areas in the irrigated parts of the county commonly are used for irrigated pasture. Improving water intake and tilth is the main concern in management. Clayey range site; capability unit IVs–3; windbreak group 4.

Pierre clay, 2 to 6 percent slopes (PrB).—This soil is on uplands. Areas are irregular in shape and range from 15 to 500 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Hisle, Kyle, and Stetter soils. Hisle and Kyle soils are on foot slopes, in some swales, and along drainageways. Stetter soils also are along some drainageways. Included soils make up less than 25 percent of any given area.

This Pierre soil has low fertility and poor tilth. It

takes in water very slowly. Runoff is medium. Erosion and soil blowing are hazards.

Most of the acreage is in native grass and is used for range. Wheat is the main crop in cultivated areas. A few areas are used for irrigated pasture. Controlling erosion and soil blowing is the main concern in management. Clayey range site; capability unit IVe–3; windbreak group 4.

Pierre clay, 6 to 21 percent slopes (PrD).—This soil is in irregularly shaped areas that range from 20 to more than 500 acres in size. It has a profile similar to the one described as representative of the series, but in places the depth to shale is slightly less than 20 inches.

Included with this soil in mapping are areas of Hisle, Kyle, Lismas, and Stetter soils. Hisle and Kyle soils are on foot slopes and along some drainageways. Lismas soils are on the tops and upper sides of ridges and on the shoulders of some drainageways. Stetter soils are on narrow bottom land along the larger drainageways. Included soils make up less than 20 percent of any given area.

This Pierre soil has low fertility and takes in water slowly. Runoff is medium or rapid, depending on slope. Erosion is a hazard.

Most of the acreage is in native grass and is used for grazing. Wheat is the main crop in the few cultivated areas. Controlling erosion is the main concern in management. Clayey range site; capability unit VIe–4; windbreak group 10.

Ralph Series

The Ralph series consists of moderately deep, gently sloping, well-drained loamy soils on uplands. These soils formed in material derived from sandstone, siltstone, and shale.

In a representative profile the surface layer is grayish-brown loam about 6 inches thick. The subsoil, about 21 inches thick, is grayish-brown clay loam in the upper part and calcareous, light brownish-gray clay loam in the lower part. The upper part is slightly hard when dry and friable when moist. The lower part contains spots and streaks of soft lime that extend into the underlying material. The underlying material to a depth of 34 inches is calcareous, light brownish-gray clay loam. Below a depth of 34 inches is calcareous, gray shale and pale-olive soft sandstone.

Ralph soils have medium fertility and moderate or low available water capacity. Permeability is moderate, and runoff is medium.

Most areas are used for range. Small grain and alfalfa are the main crops in cultivated areas. The native vegetation is mainly mid and short grasses.

Representative profile of Ralph loam, 3 to 6 percent slopes, in native grass, 1,400 feet south and 700 feet west of the northeast corner of sec. 29, T. 14 N., R. 6 E.:

A1—0 to 6 inches, grayish-brown (2.5Y 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, friable; many roots; neutral; clear, smooth boundary.

B2t—6 to 17 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky and blocky; slightly hard, friable; common roots; thin continuous clay films; neutral; clear, wavy boundary.

B3ca—17 to 27 inches, light brownish-gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; moderate, medium and coarse, prismatic structure parting to moderate, medium and coarse, blocky; hard, firm; common roots; thin patchy clay films; many, medium, distinct segregations of lime; violent effervescence; mildly alkaline; clear, wavy boundary.

C1ca—27 to 34 inches, light brownish-gray (2.5Y 6/2) light clay loam, olive brown (2.5Y 4/4) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable; discontinuous layer of hard limestone in lower part; few roots; many, medium, distinct segregations of lime; violent effervescence; mildly alkaline; clear, wavy boundary.

C2—34 to 51 inches, gray (5Y 6/1 and 5/1) soft shale, olive gray (5Y 4/2) and very dark gray (5Y 3/1) moist; many, medium, prominent mottles of yellowish red (5YR 4/6); bedded, crushes to clay loam; strong effervescence; moderately alkaline; clear, wavy boundary.

C3—51 to 60 inches, pale-olive (5Y 6/3) soft sandstone, olive (5Y 5/3) moist; common, fine, prominent, strong-brown (7.5YR 5/6) mottles; bedded, crushes to loamy fine sand; slight effervescence; mildly alkaline.

Depth to bedrock ranges from 20 to 40 inches, and depth to free carbonates ranges from 8 to 21 inches. The solum ranges from 16 to 30 inches in thickness. The A horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. It commonly is loam, but ranges from very fine sandy loam to light clay loam. The A horizon ranges from 3 to 6 inches in thickness. The B2t horizon ranges from dark grayish brown to light olive brown in hue of 10YR or 2.5Y. It is clay loam or heavy loam that ranges from 25 to 35 percent clay and is less than 15 percent coarser than very fine sand. The B2t horizon has weak or moderate, prismatic structure parting to moderate or strong, subangular blocky or blocky. It has thin or moderately thick clay films. The B3 and C horizons have a wide range in color, which is largely inherited from the bedrock. The bedrock is sandstone, siltstone, or sandy to clayey shale.

Ralph soils are near Absher, Belfield, Cabbart, Oburn, and Scroggin soils. They contain less clay and less sodium in the B horizon than Absher, Belfield, and Oburn soils. They are deeper over bedrock than Cabbart soils. They have a B horizon and are less calcareous than Scroggin soils.

Ralph loam, 3 to 6 percent slopes (RaB).—This soil is on uplands. Areas are irregular in shape and are mainly less than 100 acres in size.

Included with this soil in mapping are areas of Absher, Assinniboine, Belfield, and Scroggin soils. Absher and Belfield soils commonly are on foot slopes and in drainage sags. Assinniboine and Scroggin soils are on the crests of ridges in the higher parts of the landscape. Also included are clayey soils in some of the mapped areas in T. 14 N., R. 1 E. and in the vicinity of Deer's Ears Buttes. Included soils commonly make up less than 15 percent of any given area, but the areas of clayey soils make up as much as 30 percant.

This Ralph soil has medium fertility and low or moderate available water capacity. Runoff is medium. Erosion is a hazard in cultivated areas.

Most of the acreage is in native grass and is used for range. Small grain and alfalfa are the main crops in cultivated areas. Controlling erosion is the main concern in management. Silty range site; capability unit IIIe–1; windbreak group 3.

Razor Series

The Razor series consists of moderately deep, nearly level to strongly sloping, well-drained silty soils on uplands. These soils formed in calcareous material weathered from the underlying shale.

In a representative profile the surface layer is light brownish-gray silty clay loam about 2 inches thick. The subsoil, about 18 inches thick, is silty clay loam that is grayish brown in the upper 2 inches and light brownish gray in the rest. It is hard and very hard when dry and firm when moist. Except for the upper 2 inches, the subsoil is calcareous. The underlying material to a depth of 30 inches is calcareous, light olive-gray silty clay loam that contains many spots and streaks of soft lime. Below a depth of 30 inches is calcareous, light olive-gray shale.

Razor soils have low fertility and available water capacity. Permeability is slow, and runoff is slow or medium.

Most areas are used for range. Small grain and alfalfa are the main crops in the few cultivated areas. Alfalfa is the main irrigated crop. The native vegetation is mainly mid and short grasses.

Representative profile of Razor silty clay loam in an area of Midway-Razor silty clay loams, 3 to 15 percent slopes, in native grass, 1,660 feet east and 1,900 feet north of the southwest corner of sec. 7, T. 9 N., R. 3 E.:

A1—0 to 2 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, thin, platy structure parting to weak, fine, crumb; hard, friable, slightly sticky and slightly plastic; many roots; neutral; clear, smooth boundary.

B21—2 to 4 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, firm, slightly sticky and plastic; many roots; neutral; clear, wavy boundary.

B22ca—4 to 14 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; very hard, firm, slightly sticky and plastic; common roots; strong effervescence; moderately alkaline; clear, wavy boundary.

B3ca—14 to 20 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; few, prominent, strong-brown (7.5 YR 5/6) mottles; moderate, medium, subangular blocky structure; very hard, firm, slightly sticky and plastic; common roots; strong effervescence; moderately alkaline; clear, wavy boundary.

C1ca—20 to 30 inches, light olive-gray (5Y 6/2) silty clay loam, olive gray (5Y 5/2) moist; many, medium and coarse, yellowish-brown (10YR 5/6) and light olive-brown (2.5Y 5/4) mottles; weak, coarse, subangular blocky structure; very hard, firm, slightly sticky and plastic; few roots; fragments of olive-gray shale make up about 20 percent of the mass; many coarse segregations of lime; strong effervescence; moderately alkaline; diffuse, wavy boundary.

C2—30 to 48 inches, light olive-gray (5Y 6/2) shale, olive gray (5Y 5/2) moist; very hard, firm, slightly sticky and plastic; thick salt coatings in upper part and diminishing with increasing depth; strong effervescence; moderately alkaline.

Depth to bedrock ranges from 20 to 40 inches, and depth to carbonates ranges from 4 to 10 inches. In cultivated areas, the A1 and B21 horizons commonly are calcareous. The soil is neutral or mildly alkaline in the A1 and B21 horizons and mildly alkaline or moderately alkaline below. The A1 horizon is grayish brown or light brownish gray in hue of 2.5Y or 10 YR. It is silt loam or silty clay loam and ranges from 1 to 4 in thickness. The B horizon is hard or very hard when dry and firm or very firm when moist. The B21 horizon is grayish brown or brown in hue of 2.5Y or 10 YR. It ranges from 35 to 45 percent clay. It ranges from 2 to 6 inches in thickness, but in cultivated areas it commonly is mixed with the B22ca horizon. The B22ca and B3ca horizons are grayish brown or light brownish gray in hue of 2.5Y or 10YR. The C1ca horizon ranges from grayish brown to light olive gray in hue of 2.5Y or 5Y. Segregations of lime are common or many.

Razor soils are mapped with Midway soils, are near Baca soils, and are similar to Minnequa and Pierre soils in depth to bedrock. They are more shallow over bedrock than Baca soils and are deeper over bedrock than Midway soils. They are more clayey and less calcareous than Minnequa soils and are less clayey than Pierre soils.

Razor silty clay loam, 0 to 2 percent slopes (RcA).—This soil is in irregularly shaped areas that range from 10 to 400 acres in size. This soil has a profile similar to the one described as representative of the series, but in places the surface layer is slightly thicker, and in cultivated areas the surface layer commonly is calcareous.

This soil has low fertility. It takes in water slowly and has low available water capacity. Runoff is slow.

Many areas are in native grass and are used for range. Other areas are cultivated. Alfalfa is the main irrigated crop. Winter wheat is the main dryfarmed crop. Improving fertility and water intake and controlling soil blowing are the main concerns in management. Clayey range site; capability units IVes-2 irrigated and IIIs-1 dryland; windbreak group 4.

Razor silty clay loam, 2 to 6 percent slopes (RcB).—This soil is on uplands. Areas are irregularly shaped and range from 10 to 350 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is calcareous in some cultivated areas and is silt loam in some areas that are in native grass.

This soil has low fertility and takes in water slowly. Runoff is medium. Erosion and soil blowing are hazards in cultivated areas.

Many areas are in native grass and are used for range. Other areas are cultivated. Alfalfa is the main irrigated crop. Winter wheat, oats, barley, and alfalfa are the main dryfarmed crops. Controlling erosion and soil blowing is the main concern in management. Clayey range site; capability units IVes–2 irrigated and IVe–3 dryland; windbreak group 4.

Razor silty clay loam, 6 to 9 percent slopes (RcC).—This soil is on uplands. Areas range from 10 to 200 acres in size. Included in mapping are areas of Midway soils in the higher parts of the landscape.

This Razor soil has low fertility. It takes in water slowly and has low available water capacity. Runoff is medium. Erosion is a hazard in cultivated areas.

Most of the acreage is in native grass and is used for range. Winter wheat is the main crop in the few cultivated areas. Controlling erosion and soil blowing is the main concern in management. Clayey range site; capability unit VIe–4; windbreak group 10.

Redig Series

The Redig series consists of deep, gently sloping to moderately steep, well-drained, calcareous loamy soils that have thick white layers of high gypsum concentration. These soils are on terraces or terrace remnants on uplands. They formed in old alluvium that contains sand, silt, clay, and coarse fragments of mixed mineral origin.

In a representative profile the surface layer, about 7 inches thick, is grayish-brown clay loam in the upper part and light brownish-gray loam in the lower part. It is slightly hard when dry and friable when moist. The underlying material is white loam in the upper part, white and light brownish-gray gravelly loam in the middle, and light brownish-gray and light-gray gravelly clay loam in the lower part. It contains many gypsum crystals. The entire profile is calcareous and contains angular and rounded gravel in amounts that increase with increasing depth.

Redig soils have low fertility and low or moderate available water capacity. Permeability is moderate, and runoff is medium or rapid.

Almost all the areas are used for range. The native vegetation is mainly short and mid grasses.

Representative profile of Redig clay loam, 9 to 25 percent slopes, in native grass, 2,490 feet west and 700 feet south of the northeast corner of sec. 5, T. 9 N., R. 7 E.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard, friable, slightly sticky; many roots; about 10 percent coarse fragments; slight effervescence; neutral; clear, smooth boundary.

A12—3 to 7 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky; many roots; about 12 percent coarse fragments; strong effervescence; mildly alkaline; clear, wavy boundary.

C1cs—7 to 18 inches, white (10YR 8/1) loam, pale brown (10YR 6/3) moist; massive; hard, friable, slightly sticky; common roots; about 10 percent coarse fragments; many gypsum crystals; coarse fragments coated with lime; violent effervescence; mildly alkaline; gradual, wavy boundary.

C2cs—18 to 30 inches, white (10YR 8/1) gravelly loam, light brownish gray (2.5Y 6/2) moist; massive; hard, friable, slightly sticky; few roots; about 15 to 20 percent coarse fragments; many gypsum crystals; coarse fragments coated with lime; violent effervescence; mildly alkaline; clear, wavy boundary.

C3csca—30 to 45 inches, light brownish-gray (2.5Y 6/2) gravelly loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, friable, slightly sticky; about 20 to 35 percent coarse fragments; many gypsum crystals; coarse fragments coated with lime; violent effervescence; mildly alkaline; gradual, wavy boundary.

C4ca—45 to 60 inches, light brownish-gray (2.5Y 6/2) and light-gray (2.5Y 7/2) gravelly clay loam, grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) moist; many, fine, yellowish-brown (10YR 5/6) mottles; massive; soft, friable, slightly sticky; about 30 to 50 percent coarse fragments; common gypsum crystals; coarse fragments coated with lime; violent effervescence; mildly alkaline.

Depth to bedrock is more than 40 inches. In places the upper 2 to 4 inches of the soil is noncalcareous. The content of coarse fragments in the soil ranges from about 3 to 15 percent in the upper part and from 15 to 50 percent in the lower part. The A horizon ranges from dark grayish brown to pale brown in hue of 10YR or 2.5Y. It ranges from 4 to 10 inches in thickness. The Ccs horizon ranges from pale yellow to white in hue of 10YR or 2.5Y. It ranges from 18 to 35 percent clay. It is about 30 to 40 percent gypsum and contains at least 5 percent more gypsum than the underlying Cca horizon. The calcium carbonate equivalent ranges from 5 to 10 percent.

Redig soils are near Bidman, Caputa, and Schamber soils. They differ from those soils in having horizons that are high in content of gypsum.

Redig clay loam, 9 to 25 percent slopes (RdE).—This soil is on terrace remnants scattered throughout the uplands. Areas are mostly less than 25 acres in size. Some contain small gullies.

Included with this soil in mapping are areas of Bidman, Caputa, and Schamber soils. Bidman and Caputa soils are in small, less sloping parts of the landscape. Schamber soils are in places where pockets of gravel are at or near the surface.

This Redig soil has low fertility and is high in content of gypsum. Runoff is medium or rapid, depending on slope. Erosion is a hazard.

Most of the acreage is in native grass and is used for range. Controlling erosion is the main concern in management. Thin Upland range site; capability unit VIe–3; windbreak group 10.

Riverwash

Riverwash (0 to 3 percent slopes) (Rh) is recent deposits of alluvium along the Belle Fourche River and some of its tributaries. The sediments range from sand to clay. The areas periodically receive fresh deposits of sediment and are subject to scouring action by floodwaters.

Most areas support little or no vegetation. Scattered trees and tall grasses are in some of the more stable areas and provide a limited amount of grazing. Riverwash has little value for farming and is better suited to wildlife habitat than to other uses. Capability unit VIIIe–1; windbreak group 10; not assigned to a range site.

Rock Outcrop

Rock outcrop-Spearfish complex, 25 to 50 percent slopes (RsF) is about 60 percent Rock outcrop, 30 percent Spearfish soils, and 10 percent other soils. Areas are irregular in shape and range from 50 to 250 acres in size. Eroding gullies are in many areas. Rock outcrop commonly is in the steeper parts of the areas and consists of exposed ledges of reddish-colored, fine-grained sandstone and siltstone (fig. 16). It is consolidated bedrock that can be chipped easily by a spade. Spearfish soils are both below and above areas of Rock outcrop. They have a profile similar to the one described as representative of the Spearfish series, but surface stones are common in many areas. Nevee soils are the most common of the other soils included in mapping. They are on fans and foot slopes on the lower parts of the landscape.

Runoff is very rapid on Rock outcrop and rapid on the Spearfish soils.

This complex is in native vegetation and provides a limited amount of grazing. The native vegetation is scattered ponderosa pine, cedar, and grasses, but

Figure 16.—**Rock outcrop-Spearfish complex, 25 to 50 percent slopes.**

Rock outcrop supports little or no vegetation. Rock outcrop in capability unit VIIIs–1 and not assigned to a range site or windbreak group; Spearfish soil in Shallow range site, capability unit VIIs–1, and windbreak group 10.

Saline-Alkali Land

Saline-Alkali land (0 to 15 percent slopes) (Sa) is high in content of salts as a result of seepage from stock water ponds and irrigation canals, or as a result of shale seeps and collection of runoff water from surrounding uplands. Areas are strongly alkaline or have a high content of exchangeable sodium. Some areas are nearly level salt flats, and others are in swales, along drainageways, or on strongly sloping sides of upland ridges.

Included with this land in mapping are areas of Broadhurst, Lismas, Swanboy, and Wasa soils. Broadhurst soils are along Middle Creek and its tributaries west of Belle Fourche. Lismas and Wasa soils are on uplands. Swanboy soils are in some swales and along some drainageways.

Saline-Alkali land is wet throughout the year and has high concentrations of salts. The native vegetation is very sparse stands of salt-tolerant plants. Some areas are barren. Grazing use is very limited. Capability unit VIIIs–3; not assigned to a range site or windbreak group.

Saline Alluvial Land

Saline alluvial land (0 to 3 percent slopes) (Sd) consists of long, narrow strips of alluvial soils that have a high content of salt. Strips along drainageways are commonly more than 2,600 feet long and 50 to 500 feet wide. Texture ranges from clay to loam, and distinct crusts of white salts are on the surface. The salt content is high enough to affect the composition of the natural plant community. Included in mapping are small areas of unnamed alluvial soils that contain less salts.

Saline alluvial land commonly is wet throughout the year. It is subject to overflow and in most areas has a high water table and receives seepage from stock water ponds.

This land is in native grass and is used for grazing. It is too saline for cultivation. Saline Lowland range site; capability unit VIIs–9; windbreak group 10.

Satanta Series

The Satanta series consists of deep, nearly level to sloping, well-drained loamy soils on terraces. These soils formed in loamy alluvium that has been partly reworked by wind.

In a representative profile the surface layer is grayish-brown loam about 8 inches thick. The subsoil, about 23 inches thick, is brown clay loam in the upper part and grayish-brown sandy clay loam in the lower part. The upper part is slightly hard when dry and friable when moist. The lower part is calcareous. The underlying material is calcareous, light brownish-gray loam that contains spots and streaks of soft lime.

Satanta soils have medium fertility and high available water capacity. Permeability is moderate, and runoff is slow or medium.

Some areas are cultivated. Winter wheat is the main dryfarmed crop, but other small grains, corn, and alfalfa also are grown. Corn and alfalfa are the main irrigated crops. Other areas are used for range. The native vegetation is mainly mid and short grasses.

Representative profile of Satanta loam, 0 to 2 percent slopes, in a cultivated area, 20 feet south and 15 feet east of the northwest corner of sec. 20, T. 8 N., R. 3 E.:

Ap1—0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10 YR 3/2) moist; weak, fine, granular structure; loose, very friable; many roots; slightly acid; clear, smooth boundary.

Ap2—2 to 8 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, friable; many roots; slightly acid; abrupt, smooth boundary.

B21t—8 to 15 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate, medium, prismatic structure parting to moderate, medium and fine, blocky; slightly hard, friable; common roots; thin continuous clay films; slightly acid; clear, smooth boundary.

B33t—15 to 23 inches, brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure parting to moderate, medium and coarse, subangular blocky; slightly hard, friable; common roots; thin continuous clay films on vertical faces of peds; slightly acid; gradual, wavy boundary.

B3ca—23 to 31 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; hard, friable; few roots; few fine segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C1ca—31 to 35 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; hard, friable; few roots; common coarse segregations of lime; strong effervescence; mildly alkaline; gradual, wavy boundary.

C2c1—35 to 60 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; hard, friable; common medium segregations of lime; strong effervescence; mildly alkaline.

The solum ranges from about 18 to 34 inches in thickness. Depth to carbonates ranges from 12 to 25 inches. The A horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. It commonly is loam, but in places it is fine sandy loam or very fine sandy loam. It ranges from 3 to 10 inches in thickness. The B2t horizon is grayish brown or brown in hue of 10YR or 7.5YR. It is loam, sandy clay loam, or clay loam that ranges from 20 to 35 percent clay and is more than 15 percent coarser than very fine sand. The C horizon ranges from grayish brown to pale yellow in hue of 10YR or 2.5Y. It is sandy loam to light clay loam. The B3ca and Cca horizons contain few to many segregations of lime.

Satanta soils are near Alice, Altvan, Caputa, Keith, Manter, Mawer, Redig, and Vale soils. They are more clayey in the B horizon than Alice and Manter soils and less clayey in the B horizon than Caputa soils. They are deeper over sand and gravel than Altvan and Mawer soils. They are less silty and more sandy in the B2t horizon than Keith and Vale soils. They contain less gypsum than Redig soils.

Satanta loam, 0 to 2 percent slopes (ScA).—This soil is on high terraces. Areas are irregular in shape and range from 10 to 200 acres is size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Alice, Altvan, Caputa, and Manter soils. Alice and Manter soils are on slight rises. Altvan soils are in places where gravel is at a depth of less than 40 inches. Caputa soils are intermingled with Satanta soils in the more nearly level parts of the landscape.

This Satanta soil has medium fertility and high available water capacity. Runoff is slow.

Some areas are in native grass and are used for range. Other areas are cultivated. Corn and alfalfa are the main crops in irrigated areas. Winter wheat is the main dryfarmed crop, but alfalfa and corn also are grown. Conserving moisture is the main concern in management. Silty range site; capability units I–2 irrigated and IIIc-1 dryland; windbreak group 3.

Satanta loam, 2 to 6 percent slopes (ScB).—This soil is on high terraces. Areas are irregular in shape and range from 10 to 300 acres in size.

Included with this soil in mapping are areas of Alice, Altvan, Manter, and Caputa soils. Alice, Altvan, and Manter soils are in the higher parts of the landscape in some areas. Caputa soils are on some foot slopes.

This Satanta soil has medium fertility and high available water capacity. Runoff is medium. Erosion is a hazard in cultivated areas.

Some areas are in native grass and are used for range. Others are cultivated. Alfalfa and corn are the main irrigated crops. Winter wheat and alfalfa are the main dryfarmed crops. Controlling erosion is the main concern in management. Silty range site; capability units IIIe–2 irrigated and IIIe–1 dryland; windbreak group 3.

Satanta loam, 6 to 9 percent slopes (ScC).—This soil is on high terraces. Areas are irregular in shape and range from 10 to 150 acres in size. This soil has a profile similar to the one described as representative of the series, but in places the surface layer and subsoil are thinner.

Included with this soil in mapping are areas of Alice, Caputa, and Manter soils. Alice and Manter soils are in the higher parts of some of the areas. Caputa soils are in the lower parts of the landscape.

This Satanta soil has medium fertility and high available water capacity. Runoff is medium. Erosion is a hazard.

Many areas are in native grass and are used for range. Others are cultivated. Winter wheat is the main crop, but other small grains and alfalfa also are grown. Controlling erosion is the main concern

in management. Silty range site; capability unit IVe–1; windbreak group 3.

Savo Series

The Savo series consists of deep, nearly level to gently sloping, well-drained silty soils on terraces. These soils formed in alluvium.

In a representative profile the surface layer is grayish-brown silty clay loam about 7 inches thick. The subsoil, about 13 inches thick, is grayish-brown silty clay that is very hard when dry and very firm when moist. The underlying material is calcareous silty clay loam that is light brownish gray to a depth of 37 inches and light gray below. Between depths of 20 and 25 inches it contains spots and streaks of lime and salt.

Savo soils have medium fertility and high or moderate available water capacity. Permeability is moderately slow, and runoff is slow or medium.

Many areas are cultivated and irrigated. Alfalfa and corn are the main irrigated crops. Other areas are used for range. The native vegetation is mainly mid and short grasses.

Representative profile of Savo silty clay loam, 0 to 2 percent slopes, in a cultivated area, 1,695 feet south and 100 feet west of the northeast corner of sec. 22, T. 8 N., R. 6 E.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; cloddy; hard, friable; many roots; neutral; abrupt, smooth boundary.

B2t—7 to 16 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, blocky; very hard, very firm; common roots; thin continuous clay films on vertical and horizontal faces of peds; neutral; clear, smooth boundary.

B3sa—16 to 20 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, blocky; very hard, very firm; common roots; thin patchy clay films; common segregations of salt; neutral; clear, smooth boundary.

C1casa—20 to 25 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, very firm; few roots; common segregations of salt and lime; strong effervescence; mildly alkaline; gradual, smooth boundary.

C2—25 to 37 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak, very coarse, prismatic structure; very hard, very firm; strong effervescence; mildly alkaline; clear, smooth boundary.

C3—37 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; massive; very hard, very firm; few gravel fragments; strong effervescence; mildly alkaline.

The solum ranges from 16 to 26 inches in thickness. Depth to carbonates ranges from 12 to 22 inches. The A horizon is dark grayish brown or grayish brown in hue of 10YR or 2.5Y and is silty clay loam or silt loam. The B2t horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. It is silty clay or silty clay loam and ranges from 35 to 50 percent clay. The B3 and C horizons range from grayish brown to pale yellow in hue of 2.5Y. They are clay loam, silty clay, or silt loam that in places is stratified with sandy material below a depth of 20 inches. In places sand and gravel are below a depth of 40 inches.

Savo soils are near Altvan, Keith, and Kyle soils. They contain more clay in the B horizon than Altvan and Keith soils and are deeper over sand and gravel than Altvan soils. They have an A horizon that is darker colored when moist than that of Kyle soils, and they contain less clay in the B horizon.

Savo silty clay loam, 0 to 2 percent slopes (SdA).—This soil is on terraces along the Belle Fourche River and its tributaries. Areas are irregular in shape and range from 10 to 200 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Altvan, Keith, and Kyle soils. Altvan soils are in places where gravel is at a depth of less than 40 inches. Keith soils are on slight rises. Kyle soils are along drainageways.

This Savo soil has medium fertility and high or moderate available water capacity, Runoff is slow, and intake of water is moderately slow.

Many areas are cultivated and irrigated. Alfalfa and corn are the main crops. Conserving moisture is the main concern in management of dryfarmed areas. Improving water intake is the main concern in management of irrigated areas. Silty range site; capability units IIs–1 irrigated and IIIc–1 dryland; windbreak group 3.

Savo silty clay loam, 2 to 6 percent slopes (SdB).—This soil is on terraces along the Belle Fourche River and its tributaries. Areas are irregular in shape and range from 5 to 40 acres in size. This soil has a profile similar to the one described as representative of the series, but in places the surface layer is thinner.

This soil has medium fertility and high or moderate available water capacity. Runoff is medium. Erosion is a hazard in cultivated areas.

Many areas are cultivated and irrigated. Alfalfa, corn, and small grain are the main crops. Controlling erosion is the main concern in management. Silty range site; capability units IIIe–1 irrigated and IIIe–1 dryland; windbreak group 3.

Schamber Series

The Schamber series consists of sloping to moderately steep, excessively drained loamy soils that are very shallow over gravel. These soils are on terraces and terrace remnants on uplands. They formed in gravelly terrace deposits.

In a representative profile the surface layer is calcareous, grayish-brown loam about 2 inches thick. The underlying material to a depth of 10 inches is calcareous, light brownish-gray gravelly loam that contains spots of soft lime. Below a depth of 10 inches is calcareous gravel.

Schamber soils have low fertility and low or very low available water capacity. Permeability is rapid, and runoff is slow to rapid.

Most of the acreage is used for range. The native vegetation is mainly short and mid grasses.

Representative profile of Schamber loam, 6 to 25 percent slopes, in native grass, 2,110 feet south and 1,585 feet east of the northwest corner of sec. 22, T. 11 N., R. 1 E.:

A1—0 to 2 inches, grayish-brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak, fine, granular

structure; soft, friable; few small pebbles on the surface; strong effervescence; mildly alkaline; clear, smooth boundary.

C1ca—2 to 10 inches, light brownish-gray (2.5Y 6/2) gravelly loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and fine, subangular blocky structure; slightly hard, friable; many, medium segregations of lime; violent effervescence; mildly alkaline; clear, wavy boundary.

C2—10 to 60 inches, multicolored gravel; single grained; loose; pebbles coated with lime; violent effervescence; mildly alkaline.

Gravel or gravel and sand are within a depth of 10 inches. The A1 horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is loam, sandy loam, or gravelly loam and 1 to 3 inches thick. The C1ca horizon ranges from grayish brown to pale yellow in hue of 10YR or 2.5Y. It is loam, sandy loam, gravelly loam, or gravelly sandy loam.

Schamber soils are near Bidman, Lismas, Pierre, and Redig soils. They are more gravelly and less clayey than those soils.

Schamber loam, 6 to 25 percent slopes (SeE).—This soil is in irregularly shaped areas commonly less than 25 acres in size. Slopes are short and well rounded.

Included with this soil in mapping are areas of Bidman and Redig soils. Bidman soils are on the middle and lower parts of the landscape where slopes are smoother. Redig soils are intermingled with Schamber soils. Included soils make up less than 25 percent of any given area.

This Schamber soil is low in fertility and is droughty. Runoff is slow to rapid, depending on slope.

This soil is a possible source of gravel. Almost all the acreage is in native grass and is used for range. Conserving moisture is the main concern in management. Very Shallow range site; capability unit VIIs-7; windbreak group 10.

Scroggin Series

The Scroggin series consists of moderately deep, sloping to moderately steep, well-drained, calcareous loamy soils on uplands. These soils formed in material weathered from siltstone, sandstone, and shale.

In a representative profile the surface layer is brown loam about 4 inches thick. The underlying material to a depth of 23 inches is loam that is light brownish gray in the upper part and light gray in the lower part. It is very hard when dry and friable when moist. Below a depth of 23 inches is siltstone and sandstone. All the profile above bedrock is calcareous.

Scroggin soils have low fertility and low available water capacity. Permeability is moderate above the bedrock, and runoff is medium or rapid.

Most areas are used for range. The native vegetation is mainly short and mid grasses.

Scroggin soils in Butte County are mapped only with Cabbart soils.

Representative profile of Scroggin loam in an area of Cabbart-Scroggin loams, 6 to 25 percent slopes, in native grass, 1,900 feet east and 2,000 feet north of the southwest corner of sec. 36, T. 12 N., R. 8 E.:

A1—0 to 4 inches, brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, friable; many roots; strong effervescence; neutral; clear, smooth boundary.

C1—4 to 16 inches, light brownish-gray (2.5Y 6/2) loam, light olive brown (2.5Y 5/3) moist; weak, coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; very hard, friable; common roots; many fine and medium segregations of lime; violent effervescence; moderately alkaline; gradual, smooth boundary.

C2—16 to 23 inches, light-gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/3) moist; weak, very coarse, prismatic structure; very hard, friable; few roots; common coarse segregations of lime; violent effervescence; moderately alkaline; gradual, wavy boundary.

C3—23 to 27 inches, light-gray (2.5Y 7/2) siltstone, light olive brown (2.5Y 5/3) moist; few yellowish-brown (10YR 5/6) mottles; bedded; very hard,friable; many segregations of salt and lime, on fracture faces; violent effervescence; moderately alkaline; gradual wavy boundary.

C4—27 to 40 inches, light-gray (2.5Y 7/2) and light yellowish-brown (2.5Y 6/3) fine grained sandstone, grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/3) moist; bedded; very hard, friable; moderately alkaline.

Depth to bedrock ranges from 20 to 40 inches, and depth to carbonates ranges from 0 to 10 inches. The horizons above the bedrock are loam or light clay loam that ranges from 20 to 35 percent clay and is less than 15 percent coarser than very fine sand. The A1 horizon ranges from dark grayish brown to pale brown in hue of 10YR or 2.5Y and is 2 to 5 inches thick. The C horizon above the bedrock ranges from grayish brown to pale yellow in hue of 10YR or 2.5Y. The upper few inches of the C horizon in places contains thin patchy clay films. The underlying bedrock is silty or sandy shale in places.

Scroggin soils are mapped with Cabbart soils and are near Blackhall, Ralph, and Twilight soils. They contain less sand than Blackhall and Twilight soils. They are deeper over bedrock than Cabbart soils. They do not have the B2t horizon that is characteristic of Ralph soils.

Shale Land

Shale land consists of eroding outcrops of soft shale. It is unaltered or only slightly altered by weathering.

Shale land (9 to 45 percent slopes) (Sg).—This mapping unit is about 80 percent or more eroding outcrops of soft shale and very shallow clay soils that have bedded shale within a depth of 5 inches. Slopes are short and irregular. Eroding drainageways and small gullies are in many areas.

Included with this land in mapping are areas of Lismas, Midway, Pierre, Razor, Stetter, and Wasa soils. Lismas, Midway, Pierre, Razor, and Wasa soils are in parts of the area that have a vegetative cover. Stetter soils are in narrow bottom land along the larger drainageways. Also included in some areas are small spots of Saline-Alkali land.

Runoff is very rapid, and geologic erosion is active. The areas are nearly barren of vegetation and have little value for grazing. Capability unit VIIIs-2; not assigned to a range site or windbreak group.

Shale land-Grummit complex, 15 to 45 percent slopes (ShF).—This mapping unit is about 70 percent Shale land and 30 percent Grummit soils. Areas are irregular in shape and range from 40 to 800 acres in size. Many contain small gullies. Shale land consists of eroding outcrops of slightly weathered to unaltered acid shale. Grummit soils are in the parts of

Figure 17.—Sparse vegetation on Slickspots-Wasa complex, 0 to 6 percent slopes.

the complex that have been stabilized by vegetation.

Runoff is very rapid on the Shale land part of the complex. Erosion and soil blowing are hazards.

This mapping unit is used for grazing, but the Shale land part has little or no vegetative cover. Ponderosa pine or bur oak is the dominant vegetation in some areas. Shale land in capability unit VIIIs–2 and not assigned to a range site or windbreak group; Grummit soil in Shallow range site, capability unit VIs–2, and windbreak group 10.

Slickspots

Slickspots consists of massive clayey material that is puddled on the surface and is slick when wet. The content of alkali or exchangeable sodium is high.

Slickspots-Demar complex, 0 to 6 percent slopes (SkB).—This mapping unit is about 60 percent Slickspots and 40 percent Demar soils. It is on terraces and fans. Areas range from 25 to more than 400 acres in size. Surface relief is made uneven in most areas by the small mounds or ridges that rise a few inches above the many small low spots or depressions. Slickspots are in the small depressions and support very sparse vegetation. Demar soils are on the small mounds. They have the profile described as representative of the Demar series.

These soils have poor tilth and low available water capacity. The Demar soil takes in water very slowly, and the small areas of Slickspots are almost impervious.

This mapping unit is in native vegetation and is used for range. The Slickspots part has little value for grazing. Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group; Demar soil in Claypan range site, capability unit IVs–2, and windbreak group 9.

Slickspots-Wasa complex, 0 to 6 percent slopes (SlB).—This mapping unit is about 70 percent Slickspots and 30 percent Wasa soils. Areas are irregular in shape and range from 10 to several hundred acres in size. Surface relief is made uneven by the many slight depressions between the slight rises and mounds. Slickspots are in the slight depressions and support very sparse vegetation (fig. 17). Wasa soils are on slight rises and mounds.

Included with these soils in mapping are areas of Swanboy soils and Saline-Alkali land. Swanboy soils are in places where shale is at a depth of more than

40 inches. Saline-Alkali land is along slightly depressed drainageways.

These soils have poor tilth and take in water very slowly. Runoff is medium or rapid on the Wasa soil but ponds on the areas of Slickspots until the water evaporates.

This mapping unit is in native vegetation and is used for range. The Slickspots part has little value for grazing. Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group; Wasa soil in Dense Clay range site, capability unit VIs–6, and windbreak group 10.

Snomo Series

The Snomo series consists of deep, gently sloping to moderately steep, well-drained, acid clayey soils on uplands. These soils formed in clayey material derived from acid shale.

In a representative profile the surface layer is about 7 inches thick. It is light brownish-gray clay in the upper part and gray clay in the lower part. The subsoil, about 32 inches thick, is pale-brown clay that is hard when dry and friable when moist. The underlying material is pale-brown and light brownish-gray clay to a depth of 52 inches and light brownish-gray and gray clay shale below. The entire profile above the shale is acid and contains many fine fragments of shale.

Snomo soils have low fertility and low or moderate available water capacity. Permeability is moderate, and runoff is medium.

Most areas are used for range. Alfalfa is the main crop in the few cultivated areas. The native vegetation is bur oak, ponderosa pine, and an understory of tall and mid grasses.

Representative profile of Snomo clay in an area of Snomo-Shale land complex, 3 to 25 percent slopes, in native vegetation, 2,440 feet north and 50 feet east of the southwest corner of sec. 19, T. 8 N., R. 4 E.:

A11—0 to 4 inches, light brownish-gray (10YR 6/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, platy structure; hard, friable; many roots; many very fine shale fragments; slightly acid; abrupt, wavy boundary.

A12—4 to 7 inches, gray (10YR 6/1) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, platy structure; hard, friable; many roots; many very fine shale fragments; strongly acid; abrupt, wavy boundary.

B21—7 to 23 inches, pale-brown (10YR 6/3) clay, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; common roots; many very fine shale fragments; very strongly acid; gradual, wavy boundary.

B22—23 to 39 inches, pale-brown (10YR 6/3) clay, brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; few roots; many very fine shale fragments; extremely acid; gradual, wavy boundary.

C1—39 to 52 inches, pale-brown (10YR 6/3) and light brownish-gray (10YR 6/2) clay, brown (10YR 4/3) and dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; loose, friable; few roots; many very fine shale fragments; extremely acid; gradual, wavy boundary.

C2—52 to 60 inches, light brownish-gray (10YR 6/2) and gray (10YR 5/1) clay shale, dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1) moist; yellow coatings on shale fragments; brittle; extremely acid.

The solum ranges from 28 to 43 inches in thickness. Common or many fine fragments of shale are throughout the profile. Depth to shale bedrock ranges from 40 to more than 60 inches. The A horizon is gray, grayish brown, or light brownish gray. It ranges from very strongly acid to slightly acid and is 4 to 8 inches thick. The B2 horizon ranges from brown to light yellowish brown in hue of 10YR or 7.5YR and is 60 to 70 percent clay. The B2 horizon is slightly hard or hard when dry and ranges from 24 to 35 inches thick. The C horizon above the shale ranges from grayish brown to pale brown. It is extremely acid or very strongly acid.

Snomo soils are near Graner and Grummit soils. They differ from Graner soils in having a B horizon. They are deeper over shale than Grummit soils.

Snomo-Shale land complex, 3 to 25 percent slopes (SmE).—This mapping unit is about 60 percent Snomo soils, 25 percent Shale land, and 15 percent other soils. Areas are irregular in shape and range from 20 to 900 acres in size. Stones are scattered on the surface in some areas. The Snomo soil has a profile similar to the one described as representative of the series, but in a few places the depth to shale is slightly less than 40 inches. The areas of Shale land are along eroding drainageways and consist of eroding outcrops of acid shale.

Included with these soils in mapping are areas of Graner, Grummit, Kyle, Lohmiller acid variant, and Pierre soils. Graner soils are on foot slopes and fans immediately below areas of Shale land. Grummit soils are on the tops and steep sides of ridges. Kyle and Pierre soils are in places where the underlying acid shale is mantled with alkaline clayey material. Lohmiller acid variant soils are along the larger drainageways. Also included in places are areas of a soil that is similar to this Snomo soil, but the subsoil is more firm when moist.

The Snomo soil has low fertility and low or moderate available water capacity. Runoff is slow or medium on the Snomo soil and very rapid on the Shale land. Erosion and soil blowing are hazards.

Most of the acreage is in native vegetation and is used for grazing. A few of the gently sloping soils are cultivated. Stands of bur oak and ponderosa pine are in most areas. Snomo soil in Clay Savannah range site, capability unit VIe–4, and windbreak group 10; Shale land in capability unit VIIIs–2 and not assigned to a range site or windbreak group.

Sorum Series

The Sorum series consists of deep, nearly level to gently sloping, well-drained loamy soils that have a thick surface layer of fine sandy loam and a claypan subsoil. These soils are on terraces and fans. They formed in alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 13 inches thick. Below this is a 2-inch subsurface layer of light brownish-gray fine sandy loam. The subsoil, about 18 inches thick, is clay loam that is grayish brown in the upper part and light brownish gray in the lower part. The upper part is very hard when dry and friable when moist. The lower part is calcareous and contains spots and streaks of soft lime. The underlying material is calcareous, light brownish-gray sandy loam.

Sorum soils have medium fertility and moderate

or high available water capacity. Permeability is very slow, and runoff is slow.

Most areas are in native grass and are used for range. Small grain and alfalfa are the main crops in the few cultivated areas. The native vegetation is mainly mid and short grasses.

Representative profile of Sorum fine sandy loam, 0 to 6 percent slopes, in native grass, 790 feet north and 1,690 feet west of the southeast corner of sec. 15, T. 14 N., R. 6 E.:

All—0 to 2 inches, grayish-brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very fine, granular structure; loose, very friable; many roots; medium acid; clear, smooth boundary.

A12—2 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine and medium, granular structure; soft, very friable; many roots; medium acid; clear, smooth boundary.

A13—6 to 13 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, subangular blocky structure; slightly hard, very friable; common roots; slightly acid; clear, smooth boundary.

A2—13 to 15 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium and thick, platy structure; slightly hard, very friable; common roots; mildly alkaline; abrupt, smooth boundary.

B21t—15 to 18 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (10YR 4/2) moist; strong, medium and coarse, columnar structure parting to strong, fine and medium, blocky; very hard, friable; few roots; thin continuous clay films; moderately alkaline; clear, smooth boundary.

B22tca—18 to 25 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard, friable; few roots; thin patchy clay films; common medium segregations of lime; strong effervescence; moderately alkaline; clear, smooth boundary.

B3ca—25 to 33 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; very few roots; common fine segregations of lime; strong effervescence; moderately alkaline; clear, smooth boundary.

C—33 to 60 inches, light brownish-gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The solum ranges from 25 to 40 inches in thickness. Depth to carbonates ranges from 17 to 30 inches. The A1 horizon ranges from dark gray to grayish brown in hue of 10YR or 2.5Y and is fine sandy loam, sandy loam, or loam. The A1 and A2 horizons range from 11 to 20 inches in combined thickness. The B and C horizons range from gray to pale olive in hues of 10YR to 5Y. The B2t horizon is clay loam or sandy clay loam that ranges from 20 to 35 percent clay and is more than 15 percent coarser than very fine sand. The B21t horizon has moderate or strong, medium to very coarse, columnar structure parting to moderate or strong, blocky. The B22t horizon has weak or moderate, prismatic structure parting to moderate or strong, blocky or subangular blocky. The C horizon commonly is fine sandy loam or sandy loam, but in places it is sandy clay loam or clay loam.

Sorum soils are near Absher, Archin, Assinniboine, and Chinook soils. They have a thicker A horizon than Absher and Archin soils and a less clayey B2t horizon than Absher soils. They differ from Assinniboine and Chinook soils in having columnar structure in the B2t horizon.

Sorum fine sandy loam, 0 to 6 percent slopes (SnB).—This soil is on terraces and fans. Areas are irregular in shape and range from 5 to 500 acres in size.

Included with this soil in mapping are areas of Archin, Assinniboine, Chinook, and Parshall soils. Archin, Chinook, and Parshall soils are closely intermingled with Sorum soils. Assinniboine soils are on rises merging into uplands. Also included in some low spots are areas of Slickspots. Included soils make up less than 20 percent of any given area.

This Sorum soil takes in water readily until the surface layer is saturated, but moisture penetrates the claypan subsoil very slowly. Runoff is slow. Soil blowing is a hazard in cultivated areas.

Most of the acreage is in native grass and is used for range. Small grain and alfalfa are the main crops in the few cultivated areas. Controlling soil blowing is the main concern in management. Sandy range site; capability unit IVe–12; windbreak group 5.

Spearfish Series

The Spearfish series consists of shallow, sloping to steep, well-drained silty soils on uplands. These soils formed in material weathered from the underlying reddish-colored sandstone, siltstone, or shale.

In a representative profile the surface layer is reddish-brown silt loam about 3 inches thick. Below this is a 4-inch transition layer of calcareous, reddish-brown silt loam. It is slightly hard when dry and friable when moist. The underlying material to a depth of 15 inches is calcareous silt loam that is reddish brown in the upper part and pink in the lower part. Below a depth of 15 inches is calcareous, yellowish-red sandstone.

Spearfish soils have low fertility and very low available water capacity. Permeability is moderate, and runoff is rapid.

Most areas are in native grass and are used for range. The native vegetation is mainly short and mid grasses. A few ponderosa pine, growing singly or in clumps, are in some areas.

Spearfish soils in Butte County are mapped only with Nevee soils and with Rock outcrop.

Representative profile of Spearfish silt loam in an area of Nevee-Spearfish silt loams, 6 to 25 percent slopes, in native grass, 100 feet east and 660 feet south of the northwest corner of sec. 9, T. 7 N., R. 1 E.:

A1—0 to 3 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; soft, friable; moderately alkaline; clear, smooth boundary.

AC—3 to 7 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; very weak, medium and coarse, subangular blocky structure; slightly hard, friable; slight effervescence; moderately alkaline; clear, smooth boundary.

C1—7 to 13 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

C2—13 to 15 inches, pink (5YR 7/3) silt loam, reddish brown (5YR 5/4) moist; massive; slightly hard, friable; violent effervescence; moderately alkaline; abrupt, smooth boundary.

C3—15 to 30 inches, yellowish-red (5YR 5/6) slabby sandstone, yellowish red (5YR 4/6) moist; pinkish-gray (5YR 7/2) coatings on fracture faces, reddish brown (5YR 5/4) moist; bedded; very hard; strong effervescence; strongly alkaline.

Depth to bedrock ranges from 6 to 20 inches. Colors throughout the soil are inherited from the parent rock. The horizons above the bedrock are silt loam, loam, or very fine sandy loam. The A1 horizon ranges from dark reddish gray to light yellowish brown in hues of 5YR to 10YR. In places it is calcareous and ranges from 2 to 5 inches thick. The AC and C horizons range from weak red to reddish yellow in hues of 2.5YR to 7.5YR. The bedrock is sandstone, siltstone, or shale.

Spearfish soils are mapped with Nevee soils and are near Barnum, Butche, Canyon, Colby, and Vale soils. They are more shallow over bedrock then Barnum, Colby, Nevee, and Vale soils. They have colors in more reddish hues than Butche, Canyon, and Colby soils.

Stetter Series

The Stetter series consists of deep, nearly level, well-drained clayey soils on bottom land. These soils formed in noncalcareous, clayey alluvium.

In a representative profile the surface layer and the underlying material are grayish-brown clay. The entire profile is very hard when dry, very firm when moist, and sticky and plastic when wet.

Stetter soils have low fertility and low or moderate available water capacity. Permeability is slow, and runoff is slow. Most areas are subject to flooding.

Many areas are in native grass and are used for range or hay. Alfalfa is the main crop in cultivated areas. A few areas are irrigated. The native vegetation is mainly mid grasses.

Representative profile of Stetter clay, in native grass, 2,000 feet east and 75 feet north of the southwest corner of sec. 26, T. 10 N., R. 6 E.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, thin, platy structure; very hard, very firm, sticky and plastic; neutral; clear, smooth boundary.

C—3 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, sticky and plastic; mildly alkaline.

When the soil is dry, it contains cracks, ½ inch to 2 inches wide and several feet long, that extend downward to a depth of about 20 inches. Soil colors are inherited from the alluvium and range from dark gray to light olive gray in hue of 2.5Y or 5Y. A slightly varved or platy layer of recently deposited sediment commonly is on the surface. Thin layers of calcareous material occur in places. The profile between depths of 10 and 40 inches averages 45 to 60 percent clay, but thin layers of sand or silt are in some places. The C horizon has weak blocky structure, is massive, or consists of unaltered bedding planes. The C horizon below a depth of 40 inches ranges from loamy sand to clay and in places is bedded shale.

Stetter soils are near Kyle, Lohmiller, and Swanboy soils. They differ from Kyle soils in not having a B horizon. They are less calcareous and slightly more clayey than Lohmiller soils. They contain less salts and less clay then Swanboy soils.

Stetter clay (0 to 3 percent slopes) (Sr).—This soil is on bottom land along streams. Areas are long and narrow and range to as much as several miles long and from 200 feet to several hundred feet wide. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Kyle soils and Saline alluvial land. Kyle soils are on low terrace remnants. Areas of Saline alluvial land are in small low spots or in seeps that are high in content of salts. Included soils make up less than 15 percent of any given area.

This Stetter soil takes in water slowly and has poor tilth. Runoff is slow. In some years the soil is subject to flooding.

Most of the acreage is in native grass and is used for grazing or hay. A few areas are cultivated and irrigated. Alfalfa is the main crop. Improving water intake and tilth is the main concern in management. Overflow range site; capability units IIIs–1 irrigated and IVs–3 dryland; windbreak group 4.

Stetter clay, channeled (0 to 3 percent slopes) (Ss).—This soil is on bottom land along drainageways. Areas are long and narrow, range to as much as several miles long, and are dissected into small parcels by meandering channels and old meander scars. Included in some areas are small spots of Saline alluvial land.

This soil takes in water slowly and has poor tilth. Runoff is slow, and the areas are subject to flooding in most years. Cultivation is not practical in many areas because the tracts isolated by stream channels are so small.

Most of the acreage is in native grass and is used for range. Overflow range site; capability unit VIw–2; windbreak group 10.

Stony Steep Land

Stony steep land (12 to 45 percent slopes) (St) consists of stony soils on uplands (fig. 18). Areas are irregular in shape and range from 15 to 1,500 acres in size. Stones and boulders as much as 10 feet in diameter cover 3 to 20 percent of the surface. Lismas soils are dominant in most areas. In other areas one or another of the included soils is the main soil.

Included with this land in mapping are areas of Blackhall, Cabbart, Pierre, Scroggin, Wasa, and Winler soils. Also included in places are small areas of Rock outcrop and Shale land.

Runoff is medium or rapid, and erosion is a hazard.

Stony steep land is too stony and too steep to be used for crops or hay. All the acreage is in native grass and is used for range. Shallow Dense Clay range site; capability unit VIIs–6; windbreak group 10.

Swanboy Series

The Swanboy series consists of deep, nearly level, well drained to moderately well drained clayey soils. These soils are on bottom land, terraces, and fans. They formed in clayey alluvium.

In a representative profile the surface layer, about 3 inches thick, is grayish-brown clay that has a thin light brownish-gray crust on the surface. Below the surface layer is a 14-inch transition layer of grayish-brown clay that is extremely hard when dry, very firm when moist, and very sticky and plastic when wet. It contains spots and streaks of salts. The underlying material is grayish-brown clay.

Swanboy soils have low fertility and low available water capacity. Permeability is very slow, and runoff is medium or slow.

Figure 18.—Stony steep land.

Most areas are used for range. The native vegetation is a sparse stand of mid grasses. Sagebrush and greasewood also are present in many areas.

Representative profile of Swanboy clay, 0 to 3 percent slopes, in native grass, 545 feet east and 990 feet north of the southwest corner of sec. 17, T. 13 N., R. 5 E.:

A11—0 to ½ inch, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; crust parting to weak, very fine and fine, granular structure; hard, very firm, very sticky and plastic; neutral; abrupt, smooth boundary.

A12—½ inch to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure; very hard, very firm, very sticky and plastic; neutral; clear, smooth boundary.

AC1—3 to 7 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, subangular blocky structure; extremely hard, very firm, very sticky and plastic; neutral; clear, smooth boundary.

AC2sa—7 to 17 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse and very coarse, subangular blocky structure; extremely hard, very firm, very sticky and plastic; many fine and medium segregations of salt; neutral; gradual, wavy boundary.

Csa—17 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, very firm, very sticky and plastic; few fine segregations of salt; neutral.

Colors are relatively uniform throughout the soil and range from grayish brown to pale yellow in hue of 2.5Y of 5Y. The AC and C horizons range from 60 to 75 percent clay. Depth to accumulations of salts ranges from 3 to 8 inches. The soil is calcareous in places. It ranges from neutral to moderately alkaline. Electrical conductivity is less than 2 millimhos in the part of the profile that does not have visible salts and ranges from 3 to 10 millimhos in the part that has visible salts.

Swanboy soils are near Kyle, Lismas, Pierre, Twotop, Wasa, and Winler soils. They are deeper over bedded shale than Lismas, Pierre, Wasa, and Winler soils. They are shallower over salts than Kyle and Twotop soils.

Swanboy clay, 0 to 3 percent slopes (SuA).—This soil is on valley floors, terraces, and fans. Areas are irregular in shape and range from 15 to 500 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Hisle soils and Slickspots along drainageways. Also included in places are small areas of Terrace escarpments.

This Swanboy soil has poor tilth. It takes in water very slowly and has low available water capacity. Runoff is slow or medium.

Most of the acreage is in native grass and is used for range. Dense Clay range site; capability unit VIs–6; windbreak group 10.

Swanboy-Slickspots complex (0 to 3 percent slopes) (Sv).—This mapping unit is about 40 percent Swanboy soils, 40 percent Slickspots, and 20 percent other soils. It is on bottom land and terraces. Areas range from 40 to 300 acres in size. The areas of bottom land are long and narrow, but the terraces are irregular in shape. The Swanboy soil and Slickspots are closely intermingled. Areas of Slickspots consist of massive clay material that has a puddled or "slicked-over" surface and supports little or no vegetation.

Included with this complex in mapping are areas of Arvada and Stetter soils and Saline alluvial land. Arvada soils are on small mounds or ridges within areas of Slickspots. Stetter soils and Saline alluvial land are in narrow strips along drainageway channels.

This complex has very poor tilth and takes in water very slowly. Runoff is slow or medium on the Swanboy soil and ponds on some areas of Slickspots.

Some areas are used for range. Areas of Slickspots are nearly barren and have little value for grazing. Swanboy soil in Dense Clay range site, capability unit VIs–6, and windbreak group 10; Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group.

Terrace Escarpments

Terrace escarpments (25 to 50 percent slopes) (Te) are steep, mixed soils and geologic material on terrace fronts along the Belle Fourche River and the South Fork of Moreau River. Areas are long and narrow and contain many gullies. Slopes are short and irregular. The soil material ranges from sand to clay. Included in mapping are small areas of Shale land.

Runoff is rapid, and erosion and soil blowing are hazards.

Terrace escarpments have slopes that are too steep and too irregular to be used for crops or hay. All the acreage is in native vegetation and is used for range. Thin Upland range site; capability unit VIIs–7; windbreak group 10.

Twilight Series

The Twilight series consists of moderately deep, gently sloping to moderately steep, well-drained loamy soils on uplands. These soils formed in sandy material weathered from sandstone.

In a representative profile the surface layer is brown fine sandy loam about 4 inches thick. The subsoil, about 12 inches thick, is fine sandy loam that is brown in the upper part and light brownish gray in the lower part. It is slightly hard when dry and very friable when moist. The underlying material to a depth of 28 inches is calcareous, light-gray fine sandy loam. Below a depth of 28 inches is calcareous, white, soft sandstone.

Twilight soils have low fertility and available water capacity. Permeability is moderately rapid, and runoff is slow.

Most areas are in native grass and are used for range. The native vegetation is mainly mid and short grasses and some tall grasses.

Representative profile of Twilight fine sandy loam, 3 to 25 percent slopes, in native grass, 1,700 feet east and 1,200 feet south of the northwest corner of sec. 1, T. 13 N., R. 8 E.:

A1—0 to 4 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; loose, very friable; many roots; neutral; clear, smooth boundary.

B2—4 to 10 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR) 4/3) moist; weak, coarse and very coarse, prismatic structure; slightly hard, very friable; many roots; neutral; clear, wavy boundary.

B3—10 to 16 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; very weak, very coarse, prismatic structure; slightly hard, very friable; common roots; mildly alkaline; clear, wavy boundary.

C1—16 to 28 inches, light-gray (2.5Y 7/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; few roots; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2—28 to 60 inches, white (2.5Y 8/1) weakly cemented sandstone, light brownish gray (2.5Y 6/2) moist; slightly hard, very friable; strong effervescence; moderately alkaline.

The solum ranges from about 11 to 22 inches in thickness. Depth to soft sandstone ranges from 20 to 40 inches, and depth to carbonates ranges from about 2 to 20 inches. The A1 horizon ranges from dark grayish brown to brown in hue of 10YR or 2.5Y. It is fine sandy loam or sandy loam and ranges from 3 to 6 inches in thickness. The B2 horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is fine sandy loam or sandy loam. The B3 and C horizons range from brown to light gray in hue of 10YR or 2.5Y. The underlying soft sandstone is noncalcareous in places.

Twilight soils are mapped with Assinniboine and Blackhall soils and are near Cabbart, Ralph, and Scroggin soils. They are moderately deep over sandstone and contain less clay in the B horizon than Assinniboine soils. They are deeper over soft sandstone than Blackhall soils. They are more sandy than Cabbart, Ralph, and Scroggin soils.

Twilight fine sandy loam, 3 to 25 percent slopes (TfD).—This soil is in irregularly shaped areas that range from 40 to more than 500 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Absher, Assinniboine, Blackhall, Oburn, Parshall, and Sorum soils. Absher, Assinniboine, Oburn, and Sorum soils are on foot slopes and fans in the lower parts of the landscape. Blackhall soils are on the tops and steep upper sides of ridges. Parshall soils are in drainage sags. Included soils make up about 30 percent of any given area.

This Twilight soil takes in water readily but has low or very low available water capacity. Runoff is slow. Soil blowing is a severe hazard.

Areas of this soil are in native grass and are used for range. Controlling soil blowing and erosion is the main concern in management. Sandy range site; capability unit VIe–7; windbreak group 10.

Twilight-Assinniboine fine sandy loams, 3 to 9 percent slopes (TgC).—This mapping unit is about 40 percent Twilight soils, 30 percent Assinniboine soils, and 30 percent other soils. Areas are irregular in shape and range from 40 to 500 acres in size. Relief is gently undulating to undulating or sloping. Twilight soils are on the mid and upper parts of the

landscape and have convex slopes. Assinniboine soils are in the lower parts of the complex where slopes are slightly concave.

Included with these soils in mapping are areas of Absher, Archin, Blackhall, Cabbart, Oburn, Parshall, Ralph, Sorum, and Zeona soils. Absher, Archin, Oburn, Parshall, and Sorum soils are in swales and drainage sags. Blackhall and Cabbart soils are on ridges in some areas. Ralph soils are below Cabbart soils. Zeona soils are in the more undulating areas.

These soils take in water readily, but the Twilight soils are droughty and have low fertility. Runoff is slow or medium. Soil blowing and erosion are hazards.

Most of the acreage is in native grass and is used for range. Sandy range site; Twilight soil in capability unit VIe–7 and windbreak group 10, Assinniboine soil in capability unit IVe–7 and windbreak group 5.

Twilight-Blackhall fine sandy loams, 6 to 18 percent slopes (ThD).—This mapping unit is about 60 percent Twilight soils, 20 percent Blackhall soils, and 20 percent other soils. Some of the areas are short-sloped knolls and ridges that are less than 50 acres in size. Others are broad upland areas that range to as much as several hundred acres in size. Twilight soils are in the middle parts of the landscape. Blackhall soils are in the higher parts of the landscape on the tops and upper sides of ridges. They have the profile described as representative of the Blackhall series.

Included with these soils in mapping are areas of Absher, Assinniboine, Cabbart, Oburn, and Parshall soils. Absher, Assinniboine, and Oburn soils are in the lower part of the landscape on foot slopes and fans. Cabbart soils are on some ridges. Parshall soils are in small swales.

These soils take in water readily but are droughty and have low fertility. Soil blowing and erosion are severe hazards.

Areas of this complex are in native grass and are used for range. Controlling soil blowing and erosion is the main concern in management. Capability unit VIe–7; windbreak group 10; Twilight soil in Sandy range site, Blackhall soil in Shallow range site.

Twotop Series

The Twotop series consists of deep, nearly level to sloping, well-drained clayey soils. These soils are on terraces and fans. They formed in clayey alluvium.

In a representative profile the surface layer is calcareous, grayish-brown clay about 3 inches thick. It includes a distinct crust in the upper 1/2 inch. The subsoil, about 32 inches thick, is calcareous, grayish-brown clay. It is extremely hard when dry, very firm when moist, and sticky and plastic when wet. The lower part contains many streaks and spots of gypsum and other salts. The underlying material is grayish-brown clay that is calcareous in the upper 10 inches.

Twotop soils have low fertility and low or moderate available water capacity. Permeability is very slow, and runoff is slow to rapid, depending on slope.

Most areas are in native grass and are used for range. Some areas are used for hay. The native vegetation is mainly mid grasses.

Representative profile of Twotop clay, 0 to 9 percent slopes, in native grass, 165 feet east and 1,155 feet south of the northwest corner of sec. 4, T. 13 N., R. 3 E.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; vesicular crust in upper 1/2 inch and weak, medium and fine, subangular blocky structure in lower part; very hard, very firm, sticky and plastic; common roots; slight effervescence; neutral; clear, smooth boundary.

B21—3 to 9 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure; extremely hard, very firm, sticky and plastic; common roots; slight effervescence; mildly alkaline; clear, smooth boundary.

B22—9 to 16 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; common roots; few segregations of lime; slight effervescence; mildly alkaline; clear, smooth boundary.

B3sacs—16 to 35 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; few roots; many visible segregations of salt and gypsum; slight effervescence; mildly alkaline; gradual boundary.

C1—35 to 45 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few, fine, prominent mottles of strong brown (7.5YR 5/8); massive; extremely hard, very firm, sticky and plastic; slight effervescence; mildly alkaline; gradual boundary.

C2—45 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, very firm, sticky and plastic; mildly alkaline.

The solum ranges from about 20 to 40 inches in thickness. Depth to shale is more than 40 inches and commonly is more than 60 inches. When the soil is dry, cracks 1/2 inch to 2 inches wide and several feet long extend downward through the solum. The upper 10 inches of the solum has an organic-carbon content of more than 0.58 percent and in places is noncalcareous. The A horizon ranges from dark grayish brown to pale olive in hue of 2.5Y or 5Y and is 2 to 5 inches thick. The B and C horizons range from grayish brown to pale olive in hue of 2.5Y or 5Y. They range from 60 to 72 percent clay. The B3 and C horizons contain few to many visible segregations of gypsum and other salts.

Twotop soils are near Hisle, Kyle, Lismas, Pierre, Swanboy, Wasa, and Winler soils. They do not have the columnar structure in the B2t horizon that is characteristic of Hisle soils. They do not have the compound prismatic and blocky structure in the B2 horizon of Kyle and Pierre soils. They are deeper over shale than Lismas, Wasa, and Winler soils and are deeper over segregations of salt than Swanboy soils.

Twotop clay, 0 to 9 percent slopes (ToB).—This soil is in drainage sags and on terraces and fans. Areas are irregular in shape and range from 10 to 400 acres in size.

Included with this soil in mapping are areas of Winler and Swanboy soils. Winler soils are on rises in the higher parts of some areas. Swanboy soils are on some fans and flats.

This Twotop soil has poor tilth and takes in water very slowly. Runoff is slow to rapid, depending on slope. Erosion and soil blowing are hazards in areas that have a poor vegetative cover.

Most of the acreage is in native grass and is used for grazing or hay. Dense Clay range site; capability unit VIs–6; windbreak group 10.

Vale Series

The Vale series consists of deep, nearly level, well-drained silty soils on stream terraces. These soils formed in reddish-colored alluvium.

In a representative profile the surface layer is brown silt loam about 9 inches thick. The subsoil, about 19 inches thick, is silty clay loam that is brown in the upper part and light brown in the lower part. It is hard when dry and friable when moist. The lower part is calcareous. The underlying material is calcareous very fine sandy loam that is light brown in the upper part and light reddish brown below a depth of 37 inches. Spots and streaks of soft lime are between depths of 19 and 37 inches.

Vale soils have medium fertility and high available water capacity. Permeability is moderate, and runoff is slow.

Many areas are cultivated and irrigated. Alfalfa and corn are the main crops, but the soil is well suited to all crops grown in the county. The native vegetation is mainly mid and short grasses.

Representative profile of Vale silt loam, 0 to 2 percent slopes, in crops, 1,300 feet east and 1,200 feet south of the northwest corner of sec. 14, T. 8 N., R. 5 E.:

Ap—0 to 9 inches, brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; cloddy parting to weak, fine and medium, granular structure; hard, friable; neutral; abrupt, smooth boundary.

B2t—9 to 19 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 3/4) moist; moderate, coarse, prismatic structure parting to moderate, fine and medium, blocky; hard, friable; thin continuous clay films on vertical faces of peds and thin patchy clay films on horizontal faces of peds; mildly alkaline; clear, smooth boundary.

B3ca—19 to 28 inches, light-brown (7.5YR 6/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak, coarse, prismatic structure parting to moderate, medium, blocky; hard, friable; thin patchy clay films; few fine segregations of lime; strong effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—28 to 37 inches, light-brown (7.5YR 6/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; weak, coarse, subangular blocky structure; hard, friable; many fine segregations of lime; strong effervescence; moderately alkaline; gradual boundary.

C2—37 to 60 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 4/4) moist; massive; hard, friable; slight effervescense; moderately alkaline.

The solum ranges from 25 to 40 inches in thickness. Depth to free carbonates ranges from 15 to 25 inches. The A horizon is dark brown, dark grayish brown, or brown in hue of 7.5YR or 10YR. It is silt loam or loam. The B2t horizon ranges from dark reddish gray to light brown in hue of 5YR or 7.5YR. It ranges from loam to silty clay loam that ranges from 25 to 35 percent clay and is less than 15 percent coarser than very fine sand. The B3 and C horizons range from weak red to light brown in hues of 2.5YR to 7.5YR. The C horizon ranges from sandy loam to silty clay loam. The B3 and C horizons are mildly alkaline or moderately alkaline.

Vale soils are near Altvan, Barnum, Keith, Manter, Nevee, Satanta, and Spearfish soils. They have colors in redder hues than Altvan and Keith soils and do not have the gravelly C horizon that is characteristic of Altvan soils. They have a B horizon and do not have the erratic distribution of organic matter of Barnum soils. They are less sandy than Manter soils. They have a B horizon and have less reddish colors in the A horizon than Nevee soils. They have less sand in the B2t horizon than Satanta soils. They are deeper over bedrock than Spearfish soils.

Vale silt loam, 0 to 2 percent slopes. (VaA).—This soil is on stream terraces. Areas are irregular in shape and range from 20 to 300 acres in size.

This soil has medium fertility and high available water capacity. Runoff is slow.

Many areas are cultivated and irrigated. The soil is well suited to all crops commonly grown under irrigation in the county. Conserving moisture is the main concern in management. Silty range site; capability units I–2 irrigated and IIIc–1 dryland; windbreak group 3.

Wasa Series

The Wasa series consists of moderately deep, nearly level to gently sloping, well-drained clayey soils on uplands. These soils formed in clayey material weathered from the underlying shale.

In a representative profile the surface layer is clay about 3 inches thick. The upper inch is a light brownish-gray crust, and the lower part is grayish brown. The subsoil is grayish-brown clay about 10 inches thick. It is extremely hard when dry, very firm when moist, and sticky and plastic when wet. It contains many spots and streaks of salt and gypsum that extend into the underlying material. The underlying material to a depth of 22 inches is gray clay. Below a depth of 22 inches is gray and light olive-gray shale.

Wasa soils have low fertility and very low available water capacity. Permeability is very slow, and runoff is medium or rapid, depending on slope.

Wasa soils are used entirely for range. The native vegetation is mainly a sparse stand of mid grasses.

Representative profile of Wasa clay in an area of Wasa-Slickspots complex, 0 to 6 percent slopes, in native grass, 2,090 feet west and 400 feet north of the southeast corner of sec. 26, T. 9 N., R. 7 E.:

A11—0 to 1 inch, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; crust; hard, very firm, sticky and plastic; common roots; neutral; abrupt, smooth boundary.

A12—1 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, fine, granular structure; hard, very firm, sticky and plastic; common roots; neutral; clear, smooth boundary.

B2sacs—3 to 13 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse and medium, blocky structure; extremely hard, very firm, sticky and plastic; common roots; common pressure faces; many salt and gypsum segregations; mildly alkaline; gradual, wavy boundary.

C1saca—13 to 22 inches, gray (5Y 5/1) clay, olive gray (5Y 4/2) moist; massive; extremely hard, very firm, sticky and plastic; very few roots; many salt and gypsum segregations; mildly alkaline; clear, wavy boundary.

C2—22 to 50 inches, gray (5Y 5/1) and light olive-gray (5Y 6/2) bedded clay shale, dark gray (5Y 4/1) and olive gray (5Y 5/2) moist; brownish-yellow (10YR 6/6) stains on fracture faces of shale; neutral.

The solum ranges from about 12 to 20 inches in thickness. Depth to bedded shale ranges from about 20 to 40 inches. When the soil is dry, cracks ½ inch to 2 inches wide and several feet long extend downward through the solum. The upper 10 inches of the solum has an organic-carbon content of more than 0.58 percent. Depth of visible salts and gypsum ranges from 3 to 8 inches. The soil commonly is noncalcareous, but it is calcareous in places. The A and B horizons range from grayish brown to olive in hue of 2.5Y or 5Y. The A horizon ranges from 2 to 6 inches in thickness and includes a surface crust. The B horizon ranges from 60 to 72 percent

clay. The B2 horizon has very weak or weak, medium to very coarse, blocky structure. The C1 and C2 horizons range from gray to light olive brown in hue of 5Y or 2.5Y.

Wasa soils are near Kyle, Lismas, Pierre, Swanboy, Twotop, and Winler soils. They are shallower over shale than Kyle, Swanboy, and Twotop soils and deeper over shale than Lismas soils. They contain salts at shallower depths than Pierre and Winler soils.

Wasa-Slickspots complex, 0 to 6 percent slopes (WaB).—This mapping unit is about 60 percent Wasa soils and 40 percent Slickspots. Surface relief is made uneven by mounds and ridges rising 3 to 6 inches above the many small depressions that dot the landscape. The mounds range from a few feet to several hundred feet in diameter. The ridges range from a few feet to several hundred feet in width and from 10 to 1,000 feet in length. Wasa soils are on the mounds and ridges. Areas of Slickspots are in the small depressions and consist of massive clayey material that is puddled or "slicked over" on the surface.

These soils have very poor tilth and take in water very slowly. Runoff is generally medium to rapid, but the more level areas of slickspots have very slow runoff or are ponded.

This complex is in native vegetation and is used for range. The vegetative cover is sparse, and the areas of Slickspots are nearly barren. Wasa soil in Dense Clay range site, capability unit VIs–6, and windbreak group 10; Slickspots in capability unit VIIIs–3 and not assigned to a range site or windbreak group.

Whitelake Series

The Whitelake series consists of deep, nearly level, moderately well drained loamy soils that have a claypan subsoil. These soils are on terraces. They formed in loamy to sandy alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 5 inches thick. The subsurface layer is light brownish-gray fine sandy loam about 3 inches thick. The subsoil, about 7 inches thick, is grayish-brown fine sandy loam in the upper part and calcareous, yellowish-brown sandy loam in the lower part. It is very hard when dry and very friable when moist. The underlying material to a depth of 40 inches is calcareous, light yellowish-brown and pale-brown sandy loam. Below a depth of 40 inches is calcareous gravel and sand.

Whitelake soils have medium fertility and low available water capacity. Permeability is slow in the subsoil and rapid in the underlying gravel and sand. Runoff is slow. The lower part of the profile is moist in some years because the water table is seasonally high.

Some areas are irrigated. Alfalfa, corn, and small grain are the main crops. Other areas are used for range. The native vegetation is mainly mid and short grasses.

Representative profile of Whitelake fine sandy loam in an area of Minatare-Whitelake complex, in native grass, 2,200 feet south and 1,900 feet east of the northwest corner of sec. 28, T. 8 N., R. 7 E.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; hard, very friable; many roots; neutral; clear, smooth boundary.

A2—5 to 8 inches, light brownish-gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, platy structure parting to weak, fine, granular; hard, very friable; many roots; mildly alkaline; abrupt, smooth boundary.

B2t—8 to 11 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, very coarse, columnar structure; very hard, very friable; common roots; mildly alkaline; gradual, smooth boundary.

B3ca—11 to 15 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak, very coarse, prismatic structure; very hard, very friable; common roots; slight effervescence; moderately alkaline; gradual, smooth boundary.

C1ca—15 to 22 inches, light yellowish-brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; very weak, very coarse, prismatic structure; very hard, very friable; few roots; many segregations of lime in seams and threads; violent effervescence; strongly alkaline; gradual, smooth boundary.

C2ca—22 to 40 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; very hard, very friable; many segregations of lime in seams and threads; violent effervescence; strongly alkaline; clear, smooth boundary.

IIC3—40 to 60 inches, multicolored gravel and sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 15 to 30 inches in thickness. Electrical conductivity commonly is less than 4 millimhos in the upper 15 inches, but ranges to as much as 20 in the C horizon. The A horizon ranges from dark grayish brown to brown. The B2t horizon ranges from grayish brown to pale brown. The B2t horizon has moderate, coarse or very coarse, columnar structure in the upper part and moderate, coarse or very coarse, prismatic in the lower part. In some places it has weak or moderate, blocky secondary structure. The C horizon above the gravel and sand ranges from brown to light yellowish brown. It commonly is fine sandy loam or sandy loam, but it is sandy clay loam in some places.

Whitelake soils are mapped with Minatare soils and are near Altvan and Mawer soils. They have a thicker A horizon and a less clayey B2t horizon than Minatare soils. They differ from Altvan and Mawer soils in having columnar structure in the B horizon.

Whitelake fine sandy loam, 0 to 2 percent slopes (WhA).—This soil is on terraces. Areas are irregular in shape and range from 5 to 265 acres in size.

Included with this soil in mapping are areas of Altvan, Dix, and Mawer soils in places where depth to gravel is less than 40 inches. Also included are areas of soil that is similar to this Whitelake soil but has sand and gravel at a depth of less than 40 inches.

This Whitelake soil has medium fertility. It takes in water readily, but moisture penetrates the claypan subsoil slowly. Soil blowing is a severe hazard in cultivated areas.

Many areas are cultivated and irrigated. Alfalfa is the main crop, but corn and small grain also are grown. Controlling soil blowing is the main concern in management. Sandy range site; capability units IVes–4 irrigated and IVe–12 dryland; windbreak group 5.

Winler Series

The Winler series consists of moderately deep, nearly level to sloping, well-drained clayey soils on

uplands. These soils formed in clayey material weathered from the underlying shale.

In a representative profile the surface layer is grayish-brown clay about 5 inches thick that has a platy crust in the upper half inch. The subsoil, about 17 inches thick, is grayish-brown clay. It is extremely hard when dry, very firm when moist, and sticky and plastic when wet. Below a depth of 12 inches it contains many spots and streaks of gypsum and other salts. The underlying material to a depth of 31 inches is olive shaly clay. Below a depth of 31 inches is gray clay shale.

Winler soils have low fertility and very low or low available water capacity. Permeability is very slow, and runoff is medium or rapid, depending on slope.

These soils are used almost entirely for range. The native vegetation is mainly mid grasses.

Representative profile of Winler clay, 0 to 9 percent slopes, in native grass, 50 feet east and 1,600 feet north of the southwest corner of sec. 8, T. 10 N., R. 8 E.:

A1—0 to 5 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak platy crust in upper 1/2 inch and weak, medium, subangular blocky structure in lower part; very hard, very firm, sticky and plastic; common roots; neutral; clear, smooth boundary.

B2—5 to 12 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, very coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; common pressure faces; common roots; neutral; clear, smooth boundary.

B3sacs—12 to 22 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; very weak, very coarse, subangular blocky structure; extremely hard, very firm, sticky and plastic; common pressure faces; few roots; many fine segregations of salt and gypsum; mildly alkaline; gradual, wavy boundary.

C1—22 to 31 inches, olive (5Y 5/3) shaly clay, olive (5Y 4/3) moist; common, fine and medium, prominent, yellowish-brown (10YR 5/6) mottles; massive; very hard, very firm, sticky and plastic; medium acid; gradual, wavy boundary.

C2—31 to 45 inches, gray (5Y 5/1) clay shale, very dark gray (5Y 3/1) moist; brownish-yellow (10YR 6/6) and yellowish-brown (10YR 5/6) stains on fracture faces of shale fragments.

The solum ranges from about 15 to 30 inches in thickness. Depth to bedded shale ranges from about 20 to 40 inches, and depth to accumulations of visible salts and gypsum ranges from about 8 to 20 inches. The soil commonly is noncalcareous, but it is calcareous in places. When the soil is dry, cracks 1/2 inch to 2 inches wide and several feet long extend downward through the solum. The upper 10 inches of the soil has an organic-carbon content of more than 0.58 percent. The A horizon ranges from dark grayish brown to pale olive in hue of 2.5Y or 5Y. The B and C horizons above the shale range grom grayish brown to pale olive in hue of 2.5Y or 5Y. The B horizon ranges from 60 to 72 percent clay. The B2 horizon has medium to very coarse, subangular blocky structure. The underlying shale ranges from gray to pale olive in hue of 2.5Y or 5Y.

Winler soils are near Hisle, Kyle, Lismas, Pierre, Swanboy, Twotop, and Wasa soils. They do not have the columnar structure in the B2t horizon that is characteristic of Hisle soils. They are deeper over shale than Lismas soils and are shallower over shale than Kyle, Swanboy, and Twotop soils. They do not have the compound prismatic and blocky structure of Pierre soils. They have visible salts and gypsum at greater depths than Wasa soils.

Winler clay, 0 to 9 percent slopes (WnB).—This soil is on uplands. Areas are irregular in shape and range from 25 to several thousand acres in size.

Included with this soil in mapping are areas of Lismas, Stetter, Swanboy, Twotop, and Wasa soils and Saline-Alkali land, Saline alluvial land, and Slickspots. Wasa soils, the most common inclusion, are intermingled in an erratic pattern with Winler soils. Lismas soils are on the tops and upper sides of ridges and on the shoulders of some drainageways. Swanboy and Twotop soils are in drainage sags and on fans. Stetter soils and Saline alluvial land are in narrow strips along drainageways. Saline-Alkali land is in seepy areas, and Slickspots are in slight depressions. Included soils make up 15 to 35 percent of any given area.

This Winler soil has low fertility. It takes in water very slowly and has low or very low available water capacity. Runoff is medium or rapid, depending on slope. Erosion and soil blowing are hazards.

Most of the acreage is in native grass and is used for range. Dense Clay range site; capability unit VIs–6; windbreak group 10.

Zeona Series

The Zeona series consists of deep, nearly level to gently undulating, excessively drained sandy soils. These soils are on terraces and uplands. They formed in wind-deposited sandy material.

In a representative profile the surface layer is grayish-brown loamy fine sand about 3 inches thick. The underlying material to a depth of 44 inches is light-gray and light brownish-gray fine sand. Below a depth of 44 inches is calcareous, light brownish-gray loamy fine sand.

Zeona soils have low fertility and available water capacity. Permeability is rapid, and runoff is very slow. Soil blowing is a severe hazard.

All the areas are in native grass and are used for range. The native vegetation is mainly tall and mid grasses.

Representative profile of Zeona loamy fine sand, 0 to 6 percent slopes, in native grass, 220 feet west and 100 feet south of the northeast corner of sec. 14, T. 14 N., R. 9 E.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose, very friable; medium acid; clear, smooth boundary.

C1—3 to 27 inches, light-gray (10YR 6/1) fine sand, gray (10YR 5/1) moist; single grained; loose, very friable; neutral; gradual, smooth boundary.

C2—27 to 44 inches, light brownish-gray (2.5Y 6/2) fine sand, grayish brown (2.5Y 5/2) moist; single grained; loose, very friable; neutral; gradual, smooth boundary.

C3—44 to 60 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose, very friable; slight effervescence; mildly alkaline.

Depth to calcareous material commonly is more than 40 inches. To a depth of 36 inches, the soil ranges from medium acid to neutral. Below that depth it is neutral to moderately alkaline. Evidence of recent wind action, such as thin dark layers and contrasting texture, occur in places. The A1 horizon ranges from grayish brown to pale brown in hue of 10YR or 2.5Y. It is loamy fine sand or fine sand and is loose or soft when dry. The A1 horizon ranges from 2 to 5 inches in thickness. The C horizon ranges from grayish brown to pale yellow in hue of 10YR or 2.5Y. The C horizon colors commonly have a "salt and pepper" effect because the sand grains have contrasting light- and dark-colored stains.

Zeona soils are near Archin, Assinniboine, Blackhall, Chinook, Hanly, and Twilight soils. They are more sandy than Archin, Assinniboine, Blackhall, Chinook, and Twilight soils. They are less calcareous and less stratified in texture than Hanly soils.

Zeona loamy fine sand, 0 to 6 percent slopes (ZeB).—This nearly level to gently undulating soil is on terraces and uplands. Areas are irregular in shape and range from 40 to 1,000 acres in size. Surface relief commonly is hummocky, and some areas contain sand blowouts.

Included with this soil in mapping are areas of Archin soils and Slickspots in slight depressions. Also included in places are areas of sandy soils that consist of 15 to 20 inches of wind-worked sand over bedded sandstone. Included soils make up less than 20 percent of any given area.

This Zeona soil has low fertility. It takes in water readily and has low available water capacity. Soil blowing is a severe hazard.

All the acreage is in native grass and is used for range. Controlling soil blowing is the main concern in management. Sands range site; capability unit VIe–10; windbreak group 7.

Use and Management of the Soils

Raising livestock is the main farm enterprise in Butte County. General practices of good soil management for range, dryfarmed crops, and irrigated crops and pasture are suggested on the pages that follow. The capability grouping used by the Soil Conservation Service is explained, and the capability units in the survey area are defined. Classification by capability unit of each soil in the county can be found in the mapping unit descriptions in the section "Descriptions of the Soils."

This section also contains information on the suitability of the soils for windbreaks and descriptions of wildlife areas and suggestions for the improvement of wildlife habitat. Data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures are shown in tables.

Range[3]

Native grass is the most important crop in Butte County. Livestock and livestock products account for 88 percent of the total farm income. Sheep (fig. 19) and cattle are the main types of livestock. Much of the cultivated land in the county is used to produce feed and forage for livestock. Such crops are raised in the irrigated parts of the county and help provide a feed base for the livestock industry, which depends on the vast range areas for summer grazing.

The largest range area is the Winler-Lismas association, which is dominantly of Dense Clay and Shallow Dense Clay range sites. The local term "loose gumbo" commonly is used to refer to this area. Western wheatgrass, Montana wheatgrass, and green needlegrass, as well as such forbs as wild onion and parsley, are the most common plants.

Clayey range site is dominant in the Pierre-Kyle association. Areas of this association are known locally as "the sod" and carry a true mixed prairie vegetation. The mid grasses western wheatgrass and green needlegrass are dominant, and the understory is blue grama and buffalograss. Under heavy grazing this site is reduced to a pure stand of blue grama and buffalograss.

Claypan and Sandy range sites are dominant in the Twilight-Absher and Sorum associations. Prairie sandreed, needle-and-thread, western wheatgrass, and an understory of blue grama and threadleaf sedge are the most important plants.

Several minor but distinctive range areas are in the southwestern part of the county. Shallow and Thin Upland range sites dominate the Butche-Colby association, but in addition scattered stands of ponderosa pine provide grazeable woodland. Shallow range site dominates the Grummit-Shale land association, but significant areas of Clay Savannah and Porous Clay range sites also occur. Shallow, Thin Upland, and Clayey range sites are dominant in the Midway-Penrose association. Saline Upland range site is the main range site in the Epsie association, which is mainly in Nuttall saltbush and Montana wheatgrass.

Much of the range in Butte County has been grazed by livestock for a long period of time. The resulting changes in the plant cover make it difficult to appraise the productive potential of the land unless range site and range condition techniques are used.

Range site and condition classes

A range site is a distinctive kind of range that has a particular potential for producing native plants, both in the kind and proportion of species and in the total annual yield. It supports a plant community of species different from that of other range sites if no abnormal disturbance and physical deterioration have occurred.

Range condition is the present state of the vegetation of a range site in relation to the climax, or potential, vegetation for that site. Range condition classes are an expression of the degree to which the present composition, expressed in percent, differs from that of the climax vegetation of a range site.

Four range condition classes are recognized: excellent, good, fair, and poor. A range is in excellent condition if 76 to 100 percent of the vegetation is climax vegetation of that site. It is in good condition if the percentage is 51 to 75, in fair condition if the percentage is 26 to 50, and poor if the percentage is 25 or less.

Range condition provides an approximate measure of changes that have taken place in the plant cover. It also provides a basis for predicting the nature and direction of changes to be expected in the plant community from management and treatment measures.

The range condition of an area is determined by comparing the present vegetation with the climax plant community for the site, as indicated by the

[3] By RALPH COLE and C. M. SCHUMACHER, range conservationists, Soil Conservation Service.

Figure 19.—Sheep grazing on Sandy range site in an area of Twilight-Assinniboine fine sandy loams, 3 to 9 percent slopes.

range condition guide. The vegetation is classified, according to its response to grazing use on specific range sites, as decreasers, increasers, and invaders.

Decreasers are species in the climax plant community that decrease in relative abundance if the site is subject to continued overgrazing. Increasers are species in the climax plant community that increase in relative abundance if the site is subject to continued overgrazing. Invader plants are not part of the climax plant community for the site, but invade the site as a result of various kinds of disturbance.

Descriptions of range sites

The 18 range sites of Butte County are described in the following paragraphs. Grasses that provide the major source of forage for cattle and sheep make up from 70 to 90 percent of the total annual yield on all sites in excellent condition.

The names of the soil series represented in each site are given in the site description, but this does not mean that all the soils in a given series are in that range site. To find the range site of a specific soil and the page on which it is described, refer to the "Guide to Mapping Units."

OVERFLOW RANGE SITE

This site consists of deep silty, loamy, and clayey soils of the Barnum, Glenberg, Haverson, Lohmiller variant, and Stetter series. These soils are on bottom land. They receive additional moisture during stream overflow and as runoff from adjacent soils.

In most areas the climax plant community is an excellent stand of western wheatgrass and green needlegrass. Prairie sandreed is common in areas of the Glenberg soil. Tall grasses, such as big bluestem, switchgrass, and prairie cordgrass, are common in moist stringers along stream channels. Native trees and shrubs grow on some of these stringers and are important as forage and cover for deer.

Under continuous heavy grazing, the plant cover changes to blue grama, buffalograss, or bluegrass. Some parts of this site are used for hay. Water spreading improves this site if it is to be used for this purpose.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 2,500 pounds per acre. It ranges from 2,000 pounds per acre in unfavorable years to 3,000 pounds per acre in favorable years.

SALINE LOWLAND RANGE SITE

This site consists of deep, somewhat poorly drained or poorly drained soils of the Minatare series and Saline alluvial land. These soils are on

low terraces and bottom land. The surface layer ranges from fine sandy loam to clay. The soils are wet during part of the year and have salts at or near the surface in amounts enough to affect the kind and amount of vegetation.

The climax plant community consists of alkali cordgrass, Nuttall alkaligrass, bulrush, saltgrass, and small amounts of prairie cordgrass and prairie sandreed.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 2,700 pounds per acre. It ranges from 2,000 pounds per acre in unfavorable years to 3,500 pounds per acre in favorable years.

CLOSED DEPRESSION RANGE SITE

McKenzie clay, the only soil in this site, is a deep, poorly drained clayey soil in depressions of the uplands. Runoff is ponded and remains until it evaporates. The soil is excessively wet in years of more-than-average precipitation, but is very hard and droughty during prolonged dry periods.

The climax plant community is a stand of western wheatgrass and Montana wheatgrass. This changes to a nearly pure stand of rush or spikerush if the site is overgrazed or if the soil is excessively wet for a prolonged period.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 2,400 pounds per acre. It ranges from 1,800 pounds per acre in unfavorable years to 3,000 pounds per acre in favorable years.

SANDS RANGE SITE

This site consists of deep, well-drained to excessively drained sandy soils of the Hanly and Zeona series. Surface relief commonly is uneven or hummocky. These soils have a surface layer of loamy fine sand and are underlain by loose loamy fine sand or fine sand. Available water capacity is low, but the soils take in water so readily that little or no precipitation is lost through runoff. Soil blowing is a severe hazard.

Prairie sandreed, sand bluestem, and little bluestem are the main decreasers in the climax plant community. Needle-and-thread, blue grama, and threadleaf sedge are the main increasers. Western ragweed is an important invader. Wild rose and sand cherry in some areas are important as deer browse.

Proper use of this site helps maintain an adequate plant cover and prevent soil blowing.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,750 pounds per acre. It ranges from 1,200 pounds per acre in unfavorable years to 2,300 pounds per acre in favorable years.

SANDY RANGE SITE

This site consists of deep and moderately deep, well drained and moderately well drained loamy soils of the Alice, Assiniboine, Chinook, Glenberg, Manter, Parshall, Sorum, Twilight, and Whitelake series and soils of the Mawer series that are moderately deep over sand and gravel. These soils have a surface layer of fine sandy loam. They take in moisture readily and have low to high available water capacity.

Prairie sandreed, sand bluestem, little bluestem, and big bluestem are the main decreasers in the climax plant community. Needle-and-thread, western wheatgrass, blue grama and threadleaf sedge are the main increasers.

Under continuous overgrazing, the plant cover changes to an almost pure stand of blue grama, threadleaf sedge, and stunted needle-and-thread.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,550 pounds per acre. It ranges from 1,100 pounds per acre in unfavorable years to 2,000 pounds per acre in favorable years.

POROUS CLAY RANGE SITE

Graner clay, 3 to 25 percent slopes, the only soil in this range site, is a deep, friable soil that formed in acid material weathered from shale and contains many very fine fragments of shale. This soil takes in moisture readily and has a favorable moisture content for range plants. Available water capacity is low or moderate. Soil blowing is a severe hazard.

The climax plant community is mainly prairie sandreed, sand bluestem, and little bluestem. It has the appearance of a Sands range site, but the stand is thinner and includes some western wheatgrass. Sun sedge is an important increaser.

Under continuous overgrazing, the site commonly becomes bare. Proper range use maintains an adequate plant cover, which helps control soil blowing.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,550 pounds per acre. It ranges from 1,100 pounds per acre in unfavorable years to 2,000 pounds per acre in favorable years.

SILTY RANGE SITE

This site consists of deep and moderately deep, well-drained loamy and silty soils of the Barnum, Boneek, Haverson, Keith, Ralph, Satanta, Savo, and Vale series and loamy soils of the Altvan series that are moderately deep over sand and gravel. These soils have a surface layer of loam, silt loam, or silty clay loam and a subsoil or underlying material that ranges from very fine sandy loam to silty clay. Available water capacity is moderate or low in the Altvan and Ralph soils and moderate or high in the rest.

Western wheatgrass and green needlegrass are the main decreasers in the climax plant community. Blue grama, needle-and-thread, and threadleaf sedge are the main increasers.

Under continuous overgrazing, the plant cover changes to blue grama and fringed sagewort. In addition to proper range use, range interseeding, contour furrowing or pitting, controlling the growth of sagewort, and water spreading help improve range condition.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,550 pounds per acre. It ranges from 1,100 pounds per acre in unfavorable years to 2,000 pounds per acre in favorable years.

CLAYEY RANGE SITE

This site consists of deep and moderately deep, well-drained silty, loamy, and clayey soils of the Baca, Belfield, Bidman, Caputa, Kyle, Lohmiller, Pierre, and Razor series. These soils have a surface layer that ranges from loam to clay and a subsoil or underlying material of clay loam, silty clay loam, or clay. Permeability is very slow on the Kyle and Pierre soils and moderately slow or slow on the rest. Available water capacity is moderate or high, except in the Kyle, Pierre, and Razor soils where it is very low to moderate.

Western wheatgrass and green needlegrass are the main decreasers in the climax plant community. Blue grama and buffalograss are important increasers. Low sagebrush also is important in the western part of the county.

Under continuous overgrazing, the plant cover is mainly buffalograss and blue grama. This site responds well to range interseeding and contour furrowing or pitting. Water spreading generally is beneficial, except on Pierre soils.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,550 pounds. It ranges from 1,100 pounds per acre in unfavorable years to 2,000 pounds per acre in favorable years.

CLAY SAVANNAH RANGE SITE

This site consists of deep, well-drained, friable clayey soils of the Snomo series. These soils formed in acid material weathered from shale and contain many very fine fragments of shale. They take in moisture readily and have low or moderate available water capacity. Erosion and soil blowing are hazards.

The climax plant community consists of a scattered stand of bur oak or ponderosa pine and a thin stand of grass. Little bluestem, big bluestem, and sun sedge are the main decreasers.

Under continuous overgrazing, the stand of grasses thins out and in places disappears. Proper range use helps maintain the climax plant community so that erosion and soil blowing are controlled.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,400 pounds per acre. It ranges from 1,000 pounds per acre in unfavorable years to 1,800 pounds per acre in favorable years.

DENSE CLAY RANGE SITE

This site consists of deep and moderately deep, well drained and moderately well drained clayey soils of the Broadhurst, Swanboy, Twotop, Wasa, and Winler series. These soils commonly have a crusty surface layer over a subsoil or underlying material that is very hard or extremely hard when dry. Permeability is very slow, and development of plant roots is restricted. Available water capacity is low or moderate in the Broadhurst and Twotop soils and low or very low in the other soils.

Western wheatgrass and green needlegrass are the main decreasers in the climax plant community. Montana wheatgrass is the main increaser. Wild parsley, American vetch, and wild onion are forbs that are in most areas. Low sagebrush is noticeable in the western part of the county. The plant community is distinctive in not having an understory of short grasses, such as blue grama and buffalograss.

If grazing is continuous, the stand thins out so that in dry years it is almost bare. Under good management and favorable precipitation, however, the plant cover recovers. Control of erosion is critical on this site during dry years or when the range condition is less than excellent.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,300 pounds per acre. It ranges from about 700 pounds per acre in unfavorable years to 2,000 pounds per acre in favorable years.

THIN UPLAND RANGE SITE

This site consists of deep and moderately deep, well-drained silty and loamy soils of the Colby, Manvel, Minnequa, Nevee, Redig, and Scroggin series and Terrace escarpments. The soils have a thin surface layer or are calcareous at or near the surface. Fertility and organic-matter content are low. Available water capacity ranges from low to high, and permeability is moderate or moderately slow. In most areas much precipitation is lost through surface runoff.

Needle-and-thread and western wheatgrass are the main decreasers in the climax plant community. Threadleaf sedge, blue grama, and side-oats grama are important increasers.

Under continuous overgrazing, the plant cover changes to mostly blue grama and threadleaf sedge. Contour furrowing or pitting and range interseeding are applicable to this site, except on the steeper soils.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,250 pounds per year. It ranges from 1,000 pounds per acre in unfavorable years to 1,500 pounds per acre in favorable years.

SHALLOW RANGE SITE

This site consists of well-drained to excessively drained loamy, silty, and clayey soils of the Blackhall, Butche, Cabbart, Canyon, Grummit, Midway, Penrose, and Spearfish series. These soils are shallow over bedrock and have a limited root zone. Available water capacity is very low. Permeability above the bedrock is moderately rapid to slow, but in many areas much precipitation is lost through runoff.

The climax plant community typically has an erratic pattern caused by snowdrift pattern and slight differences in position on the landscape, including slope aspect. In places little bluestem is dominant, but in other places the plant community consists of threadleaf sedge, blue grama, and small amounts of little bluestem.

Under continuous overgrazing, little bluestem is replaced by threadleaf sedge. In many areas slopes are too steep for such mechanical practices as contour furrowing or pitting and range interseeding.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,200 pounds per acre. It ranges from 900 pounds per acre in unfavorable years to 1,500 pounds per acre in favorable years.

SHALLOW TO GRAVEL RANGE SITE

Dix sandy loam, 0 to 3 percent slopes, the only soil in this site, is somewhat excessively drained and is only 10 to 20 inches deep over gravel and sand. Permeability is moderately rapid in the soil material and rapid in the gravel and sand. Available water capacity is low.

Needle-and-thread is the main decreaser in the climax plant community. Blue grama and threadleaf sedge are the main increasers.

Under continuous overgrazing, threadleaf sedge becomes the main species in the plant community. Range interseeding improves range condition, but other mechanical range improvement generally is not practical.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,100 pounds per acre. It ranges from about 900 pounds per acre in a dry year to 1,300 pounds per acre in a favorable year.

SHALLOW DENSE CLAY RANGE SITE

This site consists of shallow, excessively drained clayey soils of the Lismas series and Stony steep land. These soils have a crusty surface layer and are shallow over bedded shale. Permeability is very slow, and available water capacity is very low. Runoff is medium to very rapid.

Western wheatgrass is the main decreaser in the climax plant community. Green needlegrass, Montana wheatgrass, and plains muhly are other decreasers. Small amounts of Nuttall saltbush are in some areas. This site is distinctive in not having an understory of short grasses, such as blue grama and buffalograss.

Under continuous overgrazing, the site becomes bare and control of erosion becomes critical.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,000 pounds per acre. It ranges from 600 pounds per acre in unfavorable years to 1,400 pounds per acre in favorable years.

CLAYPAN RANGE SITE

This site consists of deep, well drained and moderately well drained loamy and silty soils of the Archin, Demar, and Oburn series. These soils have a surface layer of fine sandy loam or silty clay loam and a claypan subsoil at a depth of 5 to 10 inches. Permeability is very slow, and the claypan subsoil restricts the development of plant roots. Accumulations of salts commonly are in the lower part of the subsoil or in the underlying material.

Western wheatgrass and green needlegrass are the main decreasers in the climax plant community, but in lesser amounts than in the Silty and Clayey range sites. Blue grama and buffalograss are the main increasers. Under continuous overgrazing, the decreasers are replaced by blue grama and buffalograss.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 1,000 pounds per acre. It ranges from 800 pounds per acre in unfavorable years to 1,200 pounds per acre in favorable years.

THIN CLAYPAN RANGE SITE

This site consists of deep and moderately deep, well drained and moderately well drained loamy and silty soils of the Absher, Arvada, and Hisle series. These soils have a thin surface layer of fine sandy loam, silt loam, or loam and a claypan subsoil at a depth of less than 5 inches. The claypan subsoil is extremely hard when dry and commonly contains salts in the lower part. Permeability is very slow, and available water capacity ranges from moderate to very low.

The climax plant community commonly is low sagebrush, pricklypear cactus, blue grama, and small amounts of western wheatgrass. Under continuous overgrazing, pricklypear cactus becomes dominant.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 700 pounds per acre. It ranges from 500 pounds per acre in unfavorable years to 900 pounds per acre in favorable years.

VERY SHALLOW RANGE SITE

Schamber loam, 6 to 25 percent slopes, the only soil in this site, is underlain by gravel at a depth of less than 10 inches. Permeability is rapid, and available water capacity is low or very low.

The climax plant cover is a sparse stand of mid and short grasses. Needle-and-thread, side-oats grama, and little bluestem are the main mid grasses. Blue grama, hairy grama, and threadleaf sedge are the common short-growing plants. Forbs are common in many areas. Under continuous overgrazing, the plant cover changes to mainly threadleaf sedge and unpalatable forbs.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 600 pounds per acre. It ranges from 400 pounds per acre in unfavorable years to 800 pounds per acre in favorable years.

SALINE UPLAND RANGE SITE

This site consists of shallow and deep, well-drained, saline clayey and silty soils of the Epsie and Lohmiller series. Salts are at or near the surface. Available water is very low in the Epsie soil and moderate in the Lohmiller soil. Because the plant cover is sparse, erosion is difficult to control.

Nuttall saltbush, greasewood, or both are significant in the climax plant community. Montana wheatgrass is the main grass. Under continuous severe overgrazing, the stand of greasewood and Nuttall saltbush is killed out, leaving a very sparse stand of Montana wheatgrass and annual saltbush.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 600 pounds per acre. It ranges from 400 pounds per acre in unfavorable years to 800 pounds per acre in favorable years.

Dryfarmed Cropland[4]

Dryfarmed cropland makes up about 5 percent of

[4] By PAUL M. BODEN, conservation agronomist, Soil Conservation Service.

the land area of Butte County. The main dryfarmed areas are in the Caputa-Satanta and Pierre-Kyle associations. In other parts of the county, dryfarmed cropland consists of isolated tracts within large areas of range. Wheat is the most important crop. Alfalfa, oats, corn, and barley also are grown.

The main considerations in managing dryfarmed soils in the county are conserving moisture, controlling erosion and soil blowing, and maintaining tilth, fertility, and organic-matter content.

Conserving moisture on dryfarmed cropland in an area such as Butte County means reducing evaporation, reducing surface runoff, increasing water intake, and controlling weeds. Effective management practices to achieve these goals are use of crop residue, stubble mulching, contour farming, contour stripcropping, terracing, chiseling and subsoiling, use of field windbreaks, and minimum tillage. Fallow helps to control weeds and to increase the moisture content.

Many of these practices also help control erosion. Other practices that help control erosion are the use of close-sown crops and grassed waterways.

Practices that help control soil blowing are use of crop residue, stubble mulching, wind stripcropping, and the use of buffer strips, field windbreaks, minimum tillage, and close-sown crops. Emergency tillage roughens the surface and helps reduce soil blowing until more permanent practices are put into effect.

Measures that are effective in maintaining tilth are use of crop residue, stubble mulching, growing grasses and legumes in the cropping system, and minimum tillage. Timely tillage is important on clayey soils, such as Kyle and Pierre soils. Changing the depth of tillage from one year to another prevents the formation of a tillage pan. Chiseling and subsoiling improve soils in which a tillage pan has already formed.

Use of crop residue, grasses and legumes in the cropping system, and animal manure is among the measures that are effective in maintaining organic-matter content and fertility. Although the soils in Butte County are low or medium in natural fertility, most of the dryfarmed soils have an adequate supply of plant nutrients for crops grown in an area of limited rainfall. If these soils are cultivated for extensive periods of time, they can become deficient in nitrogen and phosphorus. The kind and amounts of commercial fertilizers needed for a given soil are best determined by soil tests and field trials. Information on soil tests and the use of commercial fertilizers is available at the office of the county agricultural extension agent.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification (*3*) can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I to VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife.
- Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuitable for cultivation and restrict their use largely to pasture or range, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture or range, woodland, wildlife, or recreation.

For some soils, two kinds of limitation have about equal importance, and the subclass symbol shows both kinds; IVes is an example.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe–1 or IVe–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Butte County are described, and suggestions for the use and management of the soils are given.

Management by dryland capability units

In the following paragraphs each of the dryland capability units in Butte County is described, and suggestions for the use and management of each capability unit are given. The capability units are not numbered consecutively because not all the units in the Statewide system are used in Butte County. Also, a soil that is part of a soil complex may be assigned to a different capability unit from the one it is assigned to if it is mapped alone. This is because the complex is treated as a whole in its management for dryfarmed cropland.

The names of the soil series in each dryland capability unit are given in the description, but this does not mean that all the soils in a particular series are in that unit. The dryland capability unit for each individual soil in Butte County is shown in the Guide to Mapping Units at the back of this survey.

CAPABILITY UNIT IIIc–1 DRYLAND

This unit consists of deep and moderately deep, gently sloping silty and loamy soils of the Boneek, Caputa, Haverson, Keith, Lohmiller, Ralph, Satanta, and Savo series. The surface layer is silty clay loam in the Lohmiller soils and loam or silt loam in the rest. The material below the surface layer ranges from loam to silty clay.

These soils are easy to work except where tillage extends into the more clayey subsoil. Available water capacity is moderate or high, and runoff is medium. Fertility is low in the Haverson and Lohmiller soils and medium in the rest. Permeability is slow in the Lohmiller soils and moderate or moderately slow in the rest.

Wheat, oats, barley, alfalfa, and tame grasses are suitable crops. Winter wheat and alfalfa are the main crops. Winter wheat is grown in sequence with summer fallow. Some cultivated areas are irrigated.

Controlling water erosion is the main concern in management. Conserving moisture, controlling soil blowing, and maintaining and improving tilth, organic-matter content, and fertility also are important. Terraces and grassed waterways are needed for erosion control. Stubble mulching or managing crop residue and stripcropping on the contour conserve moisture and also help control erosion. Grasses and legumes in the cropping system, animal manure, and commercial fertilizer all maintain and improve tilth, organic-matter content, and fertility.

CAPABILITY UNIT IIIs–1 DRYLAND

This unit consists of deep and moderately deep, nearly level silty soils of the Baca and Razor series. These soils have a surface layer and subsoil of silty clay loam. The subsoil is calcareous at a depth of less than 12 inches.

These soils have low fertility and low organic-matter content. In cultivated areas they lose their tilth and become difficult to work. Permeability and runoff are slow. Available water capacity is moderate or high in the Baca soil and low in the Razor soil.

Winter wheat and alfalfa are the main crops. Other suitable crops are oats, barley, and tame grasses. Some cultivated areas are irrigated.

Conserving moisture, controlling soil blowing, and improving tilth, organic-matter content, and fertility are all concerns in management. Grasses and legumes in the cropping system, animal manure, commercial fertilizer, use of crop residue, stubble mulching, wind stripcropping, and field windbreaks help conserve moisture, control erosion, and improve tilth, organic-matter content, and fertility.

CAPABILITY UNIT IIIs–2 DRYLAND

This unit consists of deep, nearly level silty and loamy soils of the Belfield and Bidman series. These soils have a surface layer of silt loam or loam and a subsoil of silty clay loam or clay that is extremely hard or very hard when dry. Also in this unit are Oburn soils in places where they are mapped with Belfield soils.

The Bidman soil and, in places, the Belfield soil are difficult to work because tillage commonly extends into the more clayey subsoil. Fertility is medium or low. Available water capacity is moderate or high, and permeability is slow or moderately slow. The clayey subsoil restricts growth of plant roots.

Alfalfa and tame grasses are the main crops. Other suitable crops are oats, barley, and wheat. Many areas are used for range.

Improving tilth and water intake in the clayey subsoil are the main concerns in management. Conserving moisture, controlling soil blowing, and maintaining or improving organic-matter content and fertility also are important management needs. Grasses and legumes in the cropping system, crop residue use or stubble mulching, and chiseling or subsoiling improve tilth and water intake and also conserve moisture and help control soil blowing. Animal manure and commercial fertilizer improve organic-matter content and fertility.

CAPABILITY UNIT IIIc–1 DRYLAND

This unit consists of deep, nearly level loamy and silty soils of the Caputa, Keith, Satanta, Savo, and Vale series. These soils have a surface layer of loam,

silt loam, or silty clay loam and a subsoil that ranges from silt loam to silty clay.

These soils are easy to work and have medium fertility. Available water capacity is high or moderate, and permeability is moderate or moderately slow.

Winter wheat is the main crop and is grown in sequence with summer fallow. Other suitable crops are spring wheat, oats, barley, corn, alfalfa, and tame grasses. Many areas of Keith, Satanta, Savo, and Vale soils are irrigated.

Conserving moisture is the main concern in management. Controlling soil blowing and maintaining tilth and fertility also are important. Use of crop residue or stubble mulching helps conserve moisture and control soil blowing. Wind stripcropping and field windbreaks are desirable in some areas. Grasses and legumes in the cropping system maintain tilth and fertility.

CAPABILITY UNIT IIIc-2 DRYLAND

This unit consists of deep, nearly level silty and loamy soils of the Barnum, Haverson, and Lohmiller series. These soils have a surface layer of loam, silt loam, or silty clay loam and alluvial underlying material that ranges from very fine sandy loam to silty clay loam. The soils are calcareous at or near the surface, and the alluvial material commonly is thinly stratified by finer textured or coarser textured material.

These soils have low fertility. Available water capacity is high or moderate. These soils are on bottom land, but are rarely flooded. The Barnum and Haverson soils are easy to work and have moderate permeability. The Lohmiller soils tend to lose their tilth when cultivated. They have slow permeability.

Alfalfa is the main crop. Other suitable crops are oats, barley, corn, and tame grasses. Many cultivated areas are irrigated.

Conserving moisture and improving fertility, organic-matter content, and tilth are the main concerns in management. Controlling soil blowing is important on the broader areas that are exposed to wind action. Crop residue use and stubble mulching conserve moisture and help control soil blowing. Grasses and legumes in the cropping system, animal manure, and commercial fertilizer improve fertility, organic-matter content, and tilth. Wind stripcropping and field windbreaks are desirable in some areas.

CAPABILITY UNIT IVe-1 DRYLAND

This unit consists of deep, sloping silty and loamy soils of the Boneek, Caputa, Keith, and Satanta series. These soils have a surface layer of silt loam or loam and a subsoil of silty clay loam, clay loam, or silt loam. Some cultivated areas are slightly or moderately eroded.

These soils have medium fertility. They are easy to work, except in places where tillage extends into the more clayey subsoil. Permeability is moderate or moderately slow, and available water capacity is moderate or high. Runoff is medium. The risk of erosion is severe in cultivated areas.

Alfalfa and winter wheat are the main crops. Oats, barley, and tame grasses also are suitable. Winter wheat is grown in sequence with summer fallow. Most areas are in native grass and are used for range.

Controlling erosion is the main concern in management. Conserving moisture, controlling soil blowing, and maintaining fertility and tilth also are important. Stubble mulching along with contour stripcropping or use of crop residue in combination with terraces help control erosion and soil blowing and also conserve moisture. An alternative is the use of grasses and legumes in the cropping system about half the time and good use of crop residue when growing annual crops. Grass-covered waterways help prevent formation of gullies.

CAPABILITY UNIT IVe-2 DRYLAND

Altvan loam, 2 to 6 percent slopes, the only soil in this unit, has a subsoil of clay loam and is underlain by sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. Available water capacity is low or moderate. The underlying sand and gravel holds little moisture, and the soil is somewhat droughty. Runoff is medium.

Wheat, oats, barley, alfalfa, and tame grasses are suitable crops. The small grain crops are better suited than alfalfa. Most cultivated areas are irrigated.

Controlling erosion and conserving moisture are the main concerns in management. Stubble mulching and contour farming or contour stripcropping help control erosion and also conserve moisture. An alternative is the use of grasses and legumes in the cropping system about half the time along with use of crop residue when growing annual crops.

CAPABILITY UNIT IVe-3 DRYLAND

This unit consists of deep and moderately deep, gently sloping silty and clayey soils of the Baca, Kyle, Pierre, and Razor series. These soils have a surface layer of silty clay loam or clay and a subsoil of heavy silty clay loam or clay. They are calcareous within 12 inches of the surface.

These soils are difficult to work and have low fertility. Permeability is slow or very slow. The clayey subsoil restricts the growth of roots. Runoff is medium. Available water capacity ranges from low or very low in the Pierre soil to moderate or high in the Baca soil.

Wheat, oats, barley, alfalfa, and tame grasses are suitable crops. Alfalfa grows less well on Pierre and Razor soils than on Baca and Kyle soils. Winter wheat alternated with summer fallow is the main crop. Some cultivated areas are irrigated.

Controlling water erosion and soil blowing is the main concern in management. Conserving moisture and improving tilth and fertility also are important. Stubble mulching, managing crop residue, contour farming, contour stripcropping, and grassed waterways conserve moisture and also help control water erosion and soil blowing. Terraces also help in erosion control, but are less well suited to Pierre and Razor soils because the depth to shale is moderate. Using grasses and legumes in the cropping system and chiseling or subsoiling improve tilth and water

intake. Animal manure and commercial fertilizer improve fertility.

CAPABILITY UNIT IVe—4 DRYLAND

Mawer fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is underlain by sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. It has low available water capacity and is droughty. Soil blowing is a severe hazard.

Oats, barley, and tame grasses are suitable crops. Under dryland use the soil is too droughty for such deep-rooted crops as alfalfa and corn. Many cultivated areas are irrigated.

Controlling soil blowing and conserving moisture are the main concerns in management. Stubble mulching, use of crop residue, and wind stripcropping help control soil blowing and also conserve moisture.

CAPABILITY UNIT IVe—5 DRYLAND

Mawer fine sandy loam, 2 to 6 percent slopes, the only soil in this unit, is underlain by sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. It has low available water capacity and is droughty. The soil blows easily, and runoff is high enough to cause some risk of erosion.

Oats, barley, and tame grasses are suitable crops. The soil is too droughty for such deep-rooted crops as alfalfa and corn. Many cultivated areas are irrigated.

Controlling soil blowing and erosion and conserving moisture are the main concerns in management. Stubble mulching, managing crop residue, contour farming, and wind stripcropping are among the measures that help control soil blowing and erosion and also conserve moisture.

CAPABILITY UNIT IVe—6 DRYLAND

This unit consists of deep, nearly level loamy soils of the Assinniboine, Chinook, Glenberg, Manter, and Parshall series. These soils have a surface layer and subsoil of fine sandy loam.

These soils are easy to work. Available water capacity is moderate or high, but the soils are susceptible to blowing. The Glenberg soil has low fertility, and the rest have medium fertility.

Alfalfa is the main crop. Other suitable crops are spring wheat, oats, barley, and tame grasses. Many areas are in native grass and are used for range. Many cultivated areas of Glenberg and Manter soils are irrigated.

Controlling soil blowing is the main concern in management. Conserving moisture and maintaining or improving organic-matter content and fertility also are important. Stubble mulching, use of crop residue, wind stripcropping, and field windbreaks are among the measures that help control soil blowing and also conserve moisture. Grasses and legumes in the cropping system, animal manure, and commercial fertilizer maintain or improve organic-matter content and fertility.

CAPABILITY UNIT IVe—7 DRYLAND

This unit consists of deep, gently sloping loamy soils of the Alice, Assinniboine, Glenberg, and Manter series. These soils have a surface layer of fine sandy loam and a subsoil or underlying material of fine sandy loam or sandy clay loam.

These soils are easy to work. The Glenberg soil has low fertility, and the rest have medium fertility. Available water capacity is moderate or high, and runoff is slow or medium. Permeability is moderate in the Assinniboine soils and moderately rapid in the rest.

Wheat, oats, barley, alfalfa, and tame grasses are suitable crops. Winter wheat in sequence with summer fallow is grown in some areas of Alice soils, but the risk of soil blowing is high. Many cultivated areas of Glenberg and Manter soils are irrigated.

Controlling soil blowing and erosion is the main concern in management. Conserving moisture and maintaining or improving organic-matter content and fertility also are important. Stubble mulching, use of crop residue, contour stripcropping, terraces, grassed waterways, wind stripcropping, and field windbreaks are among the measures that help control soil blowing and erosion and also conserve moisture. Grasses and legumes in the cropping system, animal manure, and commercial fertilizer maintain or improve organic-matter content and fertility.

CAPABILITY UNIT IVe—8 DRYLAND

This unit consists of deep and moderately deep, gently sloping, calcareous silty soils of the Manvel, Minnequa, and Nevee series. These soils have a surface layer and subsoil of silty clay loam or silt loam. They are calcareous at or near the surface.

These soils are high in content of lime and have low fertility. Available water capacity is low in the Minnequa soil and moderate or high in the rest. Permeability is moderate or moderately slow, and runoff is medium.

Winter wheat and alfalfa are the main crops. Other suitable crops are oats, barley, spring wheat, and tame grasses. Winter wheat is grown in sequence with summer fallow. Some cultivated areas are irrigated. Many areas are in native grass and are used for range.

Controlling erosion and soil blowing is the main concern in management. Conserving moisture and improving organic-matter content and fertility also are important. Stubble mulching in combination with contour stripcropping or contour farming help control erosion and soil blowing. Crop residue gives adequate protection where grasses and legumes are in the cropping system at least half the time. Animal manure and commercial fertilizer improve organic-matter content and fertility.

CAPABILITY UNIT IVe—9 DRYLAND

This unit consists of deep, gently sloping silty and loamy soils of the Belfield and Bidman series. These soils have a surface layer of silt loam or loam and a subsoil of silty clay loam or clay.

These soils are difficult to work where tillage extends into the more clayey subsoil. Available water capacity is moderate or high, and permeability is moderately slow or slow. The clayey subsoil is

extremely hard or very hard when dry and restricts the development of plant roots. Runoff is medium.

Alfalfa and tame grasses are the main crops. Other suitable crops are wheat, oats, and barley. Most areas are in native grass and are used for range.

Controlling erosion and soil blowing is the main concern in management. Improving tilth and fertility and conserving moisture also are important. Stubble mulching or use of crop residue in combination with contour stripcropping help control erosion and soil blowing in areas where annual crops are grown. Grasses and legumes in the cropping system and animal manure improve tilth and fertility.

CAPABILITY UNIT IVc–10 DRYLAND

Manvel silty clay loam, 0 to 2 percent slopes, the only soil in this unit, is a deep soil that is very high in content of lime.

This soil has low fertility. Available water capacity is moderate or high, and permeability is moderately slow.

Winter wheat and alfalfa are the main crops. Other suitable crops are oats, barley, and tame grasses. Winter wheat is grown in sequence with summer fallow. Some cultivated areas are irrigated. Some areas are in native grass and are used for range.

Controlling soil blowing is the main concern in management. Conserving moisture and improving organic-matter content and fertility also are important. Stubble mulching, use of crop residue, wind stripcropping, and use of field windbreaks are among the measures that help control soil blowing. Grasses and legumes in the cropping system, animal manure, and commercial fertilizer improve organic-matter content and fertility.

CAPABILITY UNIT IVc–12 DRYLAND

This unit consists of deep, nearly level and gently sloping loamy soils of the Sorum and Whitelake series. These soils have a surface layer of fine sandy loam and a claypan subsoil of clay loam or fine sandy loam.

These soils take in water readily until the surface layer is saturated. The claypan subsoil has very slow or slow permeability and restricts the development of plant roots. Runoff is slow.

Wheat, oats, barley, alfalfa, and tame grasses are suitable crops. Some cultivated areas of Whitelake soils are irrigated. Many areas are in native grass and are used for range.

Controlling soil blowing and improving water intake in the claypan subsoil are the main concerns in management. Improving tilth and conserving moisture also are important. Use of crop residue and grasses and legumes in the cropping system help control soil blowing, increase intake of water into the subsoil, and improve tilth. Stubble mulching and wind stripcropping also help control soil blowing in areas used for growing small grains.

CAPABILITY UNIT IVs–1 DRYLAND

Altvan loam, 0 to 2 percent slopes, the only soil in this unit, has a clay loam subsoil and is underlain by sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. It has low or moderate available water capacity and is somewhat droughty.

Wheat, oats, barley, tame grasses, and alfalfa are suitable crops. Deep-rooted crops, such as alfalfa and corn, are less well suited because the underlying sand and gravel holds only a small amount of moisture. Many cultivated areas are irrigated.

Conserving moisture and controlling soil blowing are the main concerns in management. Managing crop residue, stubble mulching, and wind stripcropping conserve moisture and help control soil blowing.

CAPABILITY UNIT IVs–2 DRYLAND

This unit consists of deep, nearly level claypan soils of the Archin, Demar, and Oburn series. These soils have a surface layer of fine sandy loam or loam and a claypan subsoil of sandy clay loam, clay loam, silty clay loam, or silty clay.

These soils have poor tilth and tend to puddle and crust in cultivated fields. They have low fertility. Available water capacity is low or moderate, and permeability is very slow. The claypan subsoil restricts root growth.

Wheat, oats, barley, alfalfa, and tame grasses are suitable crops. Many areas are in native grass and are used as range.

Improving tilth, water intake, and fertility are the main concerns in management. Controlling soil blowing and conserving moisture also are important. Crop residue use, grasses and legumes in the cropping system, animal manure, and chiseling and subsoiling improve tilth, water intake into the subsoil, and fertility. Stubble mulching and wind stripcropping help control soil blowing and also conserve moisture in places where annual small grains are planted.

CAPABILITY UNIT IVs–3 DRYLAND

This unit consists of deep and moderately deep, nearly level clayey soils of the Kyle, Pierre, and Stetter series. These soils are clay throughout. Pierre soils are moderately deep over shale.

These soils are difficult to work and have low fertility. Available water capacity is low or very low in the Pierre soil and low or moderate in the rest. Permeability is very slow or slow, and the clayey material restricts root growth. Runoff is slow, and in some years the Stetter soil is subject to flooding.

Winter wheat is the main crop and is grown in sequence with summer fallow. Other suitable crops are spring wheat, oats, barley, alfalfa, and tame grasses. Some cultivated areas are irrigated.

Conserving moisture and improving tilth and fertility are the main concerns in management. Controlling soil blowing also is important. Grasses and legumes in the cropping system, animal manure, commercial fertilizer, and chiseling or subsoiling improve tilth, water intake, and fertility. Stubble mulching or use of crop residue and wind stripcropping conserve moisture and help control soil blowing.

CAPABILITY UNIT VIc–3 DRYLAND

This unit consists of deep and moderately deep, sloping to moderately steep silty and loamy soils of

the Canyon, Colby, Minnequa, Nevee, Redig, and Spearfish series. These soils have a surface layer of silt loam, silty clay loam, or clay loam and are calcareous at or near the surface. The Minnequa soil is underlain by soft bedrock at a moderate depth.

These soils have low fertility and organic-matter content. Runoff is medium or rapid, and the soils are too erodible for cultivated crops.

Most areas are in native grass and are used for range. A few small areas are cultivated. Controlling erosion and soil blowing is the main concern in management. Range seeding in cultivated areas and proper range use help control erosion and soil blowing. Livestock water is obtained from wells, springs, dams, and dugouts.

CAPABILITY UNIT VIe–1 DRYLAND

This unit consists of deep and moderately deep, sloping to moderately steep clayey and silty soils of the Graner, Kyle, Pierre, Razor, and Snomo series. Pierre and Razor soils are moderately deep over soft shale.

These soils have low fertility and are too erodible for cultivation. Permeability is moderate in the Graner and Snomo soils and very slow or slow in the rest. The Graner and Snomo soils are highly susceptible to soil blowing.

Almost all of the areas are in native grass and are used for range. Controlling erosion and soil blowing is the main concern in management. Proper range use helps control erosion and soil blowing and also conserves moisture. Livestock water is obtained mainly from dams and dugouts.

CAPABILITY UNIT VIe–7 DRYLAND

This unit consists of deep and moderately deep, gently sloping to moderately steep loamy soils of the Alice, Blackhall, and Twilight series. These soils have a surface layer and underlying material of fine sandy loam. The Twilight soil is moderately deep over sandstone.

These soils have moderately rapid permeability. The Twilight soil has low available water capacity and low fertility. The soils blow easily and are too erodible for cultivated crops.

Almost all of the areas are in native grass and are used for range. Controlling soil blowing and erosion and conserving moisture are the main concerns in management. Proper range use helps control soil blowing and erosion and also conserves moisture. Shallow wells provide livestock water in most areas.

CAPABILITY UNIT VIe–8 DRYLAND

Hanly loamy fine sand, the only soil in this unit, is a nearly level, deep sandy soil on bottom land. It commonly has a hummocky surface.

This soil has low fertility. Permeability is rapid, and the available water capacity is low. The areas are subject to scouring and deposition of sediment during flooding. Disturbed areas are highly susceptible to soil blowing.

All of the areas are in native grass and are used for range. Controlling soil blowing is the main concern in management. Proper range use helps control soil blowing. Shallow wells provide livestock water.

CAPABILITY UNIT VIe–10 DRYLAND

Zeona loamy fine sand, 0 to 6 percent slopes, the only soil in this unit, is a deep, nearly level to gently undulating sandy soil. It is loamy fine sand and fine sand throughout.

This soil has low fertility. Available water capacity is low, and permeability is rapid. Disturbed areas blow easily.

All the areas are in native grass and are used for range. Controlling soil blowing is the main concern in management. Proper range use helps control soil blowing. Wells provide water for livestock.

CAPABILITY UNIT VIw–2 DRYLAND

This unit consists of deep, nearly level silty and clayey soils of the Lohmiller variant and Stetter series. These soils have a surface layer of silty clay loam or clay and underlying material of stratified alluvium that is mainly clayey.

These soils are subject to deposition of additional sediment and to streambank erosion during flooding. Meandering channels and old meander scars dissect the narrow areas into small parcels, so that cultivation is not practical.

Most areas are in native grass and are used for grazing and hay. A few areas have clumps of native trees and shrubs that provide protection for livestock and game animals. Proper range use minimizes flood damage.

CAPABILITY UNIT VIw–3 DRYLAND

This unit consists of deep, nearly level silty and loamy soils of the Barnum, Glenberg, and Haverson series and mixed alluvial soils of Loamy alluvial land. These soils have a surface layer of silt loam, fine sandy loam, or loam and underlying material of stratified alluvium that ranges from silt loam to loamy sand.

These soils are on bottom land and are subject to flooding. Streambank erosion and deposition of additional sediment commonly occur during flooding. Meandering channels and old meander scars dissect the areas into small parcels, so that, in most areas, cultivation is not practical.

Most areas are in native grass and are used for grazing or hay. Stringers and clumps of native trees and shrubs in many areas provide winter protection for game animals and livestock. Proper range use minimizes flood damage.

CAPABILITY UNIT VIs–1 DRYLAND

This unit consists of shallow, gently sloping to moderately steep loamy and silty soils of the Butche, Cabbart, Lismas, Penrose, and Scroggin series. These soils have a thin surface layer of very fine sandy loam, loam, or silty clay loam and are underlain by bedrock at a depth of less than 20 inches.

These soils have low fertility and very low or low available water capacity. Runoff is medium or rapid. These soils are too shallow and too droughty for cultivated crops. They also are subject to erosion.

All the areas are in native grass and are used for range. Proper range use helps control erosion and

conserves moisture. Wells and springs are in some areas.

CAPABILITY UNIT VIs–2 DRYLAND

This unit consists of shallow, gently sloping to moderately steep clayey and silty soils of the Grummit, Lismas, Midway, and Pierre series. These soils have a surface layer of clay or silty clay loam.

These soils have low fertility and very low available water capacity. They are too shallow and too droughty for cultivated crops. The soils also are susceptible to erosion and soil blowing.

All the areas are in native grass and are used for range. Proper range use helps control erosion and soil blowing and conserves moisture. Surface water impounded in dams is the only source of livestock water in most areas.

CAPABILITY UNIT VIs–3 DRYLAND

This unit consists of deep and moderately deep, level to sloping soils of the Absher, Arvada, Hisle, McKenzie, Minatare, and Oburn series. The McKenzie soils are clay throughout. The rest have a thin surface layer that ranges from fine sandy loam to silt loam and a claypan subsoil.

These soils have low fertility and poor tilth. Permeability is very slow, and available water capacity ranges from very low to moderate. Moisture and plant roots penetrate the subsoil or underlying material with difficulty. Runoff water ponds on the McKenzie soil for short periods in most years and remains until it evaporates.

Most areas are in native grass and are used for range. Proper range use conserves moisture and helps control erosion and soil blowing.

CAPABILITY UNIT VIs–4 DRYLAND

Dix sandy loam, 0 to 3 percent slopes, the only soil in this unit, is underlain by sand and gravel at a depth of 10 to 20 inches.

This soil has low fertility and low available water capacity. It is too droughty for dryland farming. Disturbed areas are subject to soil blowing.

Dryland areas of this soil are in native grass and are used for grazing. Proper range use conserves moisture and helps control soil blowing.

CAPABILITY UNIT VIs–5 DRYLAND

This unit consists of deep, gently sloping soils of the Oburn series. These soils have a surface layer of fine sandy loam and a claypan subsoil.

The claypan subsoil has very slow permeability and restricts plant root growth. Runoff is medium. The unfavorable root zone and the risk of erosion and soil blowing make this soil unsuitable for cultivated crops.

Most areas are in native grass and are used for grazing. Proper range use conserves moisture and helps control erosion and soil blowing.

CAPABILITY UNIT VIs–6 DRYLAND

This unit consists of deep and moderately deep, nearly level to sloping clayey soils of the Broadhurst, Swanboy, Twotop, Wasa, and Winler series. These soils have a thin crusty surface layer of clay and a subsoil of dense clay that is extremely hard when dry.

These soils have poor tilth and low fertility. Available water capacity is moderate to very low, and permeability is very slow. The dense clay subsoil severely restricts growth of plant roots. Runoff is slow to rapid. Sloping areas are susceptible to erosion.

All areas are in native grass and are used for range. Growth of grass fluctuates widely, depending on rainfall. Some areas of Twotop and Winler soils are used for hay in years of higher-than-average rainfall. Proper range use conserves moisture and helps control erosion. Dams and dugouts are the only sources of livestock water.

CAPABILITY UNIT VIIs–1 DRYLAND

Lakoa-Colby association, 9 to 50 percent slopes, the only soils in this unit, are deep silty soils on uplands. The Lakoa soil has a subsoil of clay loam and sandy clay and is underlain by sandstone. The Colby soil is silt loam to a depth of 40 inches or more.

These soils have low fertility and moderate permeability. Runoff is medium or rapid. The soils are too erodible for cultivated crops. Many areas are too steep for the use of haying machinery.

All the areas are in native vegetation, which includes stands of ponderosa pine on the Lakoa soil. The areas are used for grazing. Proper range use helps control erosion.

CAPABILITY UNIT VIIs–2 DRYLAND

This unit consists of shallow, steep loamy and silty soils of the Butche, Cabbart, Canyon, Colby, and Spearfish series. Soft bedrock is at a depth of less than 20 inches.

These soils have low fertility and very low available water capacity. Runoff is rapid, and much precipitation is lost through runoff. The soils are not suitable for cultivated crops or for the use of haying machinery.

All the areas are in native grass and are used for range. Proper range use conserves moisture and helps control erosion. Deep ravines in some areas provide habitat for game animals.

CAPABILITY UNIT VIIs–3 DRYLAND

This unit consists of shallow, gently sloping to steep clayey soils of the Epsie series and deep, nearly level silty soils of the Lohmiller series. These soils have accumulations of salts at or near the surface.

The high content of salts limits the vegetation to salt-tolerant plants. The soils are not suitable for cultivated crops. The Epsie soils are highly susceptible to erosion.

All the areas are in native grass and are used for range. Proper range use maintains the sparse plant cover and helps control erosion.

CAPABILITY UNIT VIIs–6 DRYLAND

Only Stony steep land is in this capability unit. It consists of mixed soils that are too steep and too stony for cultivated crops or hay.

Runoff is medium or rapid. Erosion is a hazard in disturbed areas.

All the areas are in native grass and are used for range. Proper range use conserves moisture and helps control erosion.

CAPABILITY UNIT VII–7 DRYLAND

This unit consists of Schamber loam, 6 to 25 percent slopes, and Terrace escarpments. The Schamber soil is underlain by gravel at a depth of 10 inches or less. Terrace escarpments is a mixture of soil and geologic material on terrace fronts. Slopes are short and irregular.

The Schamber soil has low or very low available water capacity. Runoff is slow to rapid, and erosion is a hazard.

The entire acreage is too droughty and too steep for cultivated crops or hay. It is in native grass and is used for range. Proper range use conserves moisture and helps control erosion.

CAPABILITY UNIT VII–9 DRYLAND

Only Saline alluvial land is in this capability unit. It consists of mixed alluvial soils that are high in content of salts. The areas commonly are made wet throughout the year by seepage from adjacent uplands or stock water dams. Many areas also are subject to flooding.

The high salt content makes these soils unsuitable for cultivated crops or hay. The native vegetation consists of plants that are tolerant of salts and wetness.

CAPABILITY UNIT VIIIs–1 DRYLAND

Only Riverwash is in this unit. It consists of areas of sandy to clayey alluvium that has not been stabilized by vegetation. The areas are in and adjacent to the stream channel and are subject to deposition of new sediment and scouring during flooding.

Most areas have little or no vegetation. A few scattered trees and patches of tall grasses are in some areas. The areas are suitable for wildlife habitat. Some provide a limited amount of grazing.

CAPABILITY UNIT VIIIw–1 DRYLAND

Only Marsh is in this unit. It consists of areas that are wet during much of the year and support a plant cover of water-tolerant grasses, sedges, and shrubs. The areas are better suited to habitat for wildlife than to other uses. They have little grazing value for domestic livestock.

CAPABILITY UNIT VIIIs–1 DRYLAND

This unit consists of Rock outcrop mapped in complexes with Butche, Cabbart, and Spearfish soils. These outcrops of sandstone, siltstone, and shale are steep and are mostly barren of vegetation. The areas have little value, except as scenery and for producing water in the form of runoff.

CAPABILITY UNIT VIIIs–2 DRYLAND

This unit consists of Badland, Mine pits and dumps, and Shale land. These areas include eroding exposures of soft shale and the pits and spoil banks that result from surface mining operations. The areas support little or no vegetation and are better suited to wildlife habitat and recreation than to other uses.

CAPABILITY UNIT VIIIs–3 DRYLAND

This unit consists of Saline-Alkali land and Slickspots. Areas of Saline-Alkali land are wet and very high in content of salts as a result of concentration of seepage water. Slickspots are slightly depressed spots on uplands that have a puddled or slicked-over surface. They are nearly impervious and are high in content of salts.

The areas are barren or have a very sparse cover of annuals and salt-tolerant plants. They have little or no value for grazing domestic livestock.

Predicted yields of dryfarmed crops

Table 2 shows predicted long-term average yields per acre for the principal dryfarmed crops grown in the county. The yields shown are for two levels of management. Small grain and fallow is the common dryland cropping system in the county.

The yields shown in columns A can be expected under the level of management commonly practiced in the county. Under this kind of management, crop residue is returned to the soil, but sometimes is used to provide protective cover during critical erosion periods. Little or no fertilization is practiced. Wind stripcropping to control soil blowing is a common practice. Measures to control water erosion, such as terraces, contour strips, and grassed waterways, are not used.

The yields shown in columns B can be expected under improved management, using an efficient and economical cropping system. Under this kind of management, stubble mulching of fallow land is practiced to control erosion and conserve water. Residue is maintained on the soil surface at levels of 1,000 pounds or more during critical erosion periods. Stripcropping combined with stubble mulching effectively controls soil blowing. An effective weed control program, which may include the use of herbicides, is utilized. Pesticides are also used. If water loss through runoff or erosion is a problem, contour strips, terraces, and grassed waterways are used. High-quality seed of adapted crop varieties is used.

Irrigated Land[5]

Irrigated cropland makes up about 4 percent of the land in Butte County, or about one-half of the cropland in the county. Alfalfa, corn, and edible beans are the main irrigated crops. Barley and oats also are grown.

The main source of irrigation water is the Belle Fourche Reservoir. Other sources are water diverted from the Redwater River by private ditch companies, water from wells, and water pumped from the Belle Fourche River (fig. 20). Most of this water is delivered by gravity flow to irrigated fields by a system of canals, ditches, and laterals.

[5] By PAUL M. BODEN, conservation agronomist, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre of principal dryfarmed crops under two levels of management*

[Figures in columns A indicate yields under average management; figures in columns B indicate yields under improved management. Only soils suitable for crops are listed. Absence of a figure indicates that the crop is not commonly grown on the soil specified]

Soil	Winter wheat		Spring wheat		Oats		Alfalfa	
	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Alice fine sandy loam, 2 to 6 percent slopes	18	25	9	14	20	24	1.0	1.4
Altvan loam, 0 to 2 percent slopes	17	24	11	16	18	23	.8	1.1
Altvan loam, 2 to 6 percent slopes	15	22	9	15	17	22	.7	1.0
Assiniboine fine sandy loam, 0 to 3 percent slopes	15	19	11	14	18	23	.9	1.2
Baca silty clay loam, 0 to 2 percent slopes	17	25	13	17	18	25	1.0	1.4
Baca silty clay loam, 2 to 6 percent slopes	15	23	11	15	17	23	.9	1.2
Barnum silt loam	20	27	14	18	24	30	1.3	1.7
Belfield-Oburn silt loams, 0 to 3 percent slopes	15	20	11	15	21	27	.7	1.1
Belfield-Oburn silt loams, 3 to 6 percent slopes	13	18	10	14	19	25	.6	.9
Bidman loam, 0 to 3 percent slopes	10	13	7	9	19	25	.8	1.0
Bidman loam, 3 to 6 percent slopes	8	11	6	8	16	21	.7	.9
Boneek silt loam, 2 to 6 percent slopes	22	28	15	19	21	28	1.2	1.6
Boneek silt loam, 6 to 9 percent slopes	18	23	13	18	18	25	1.0	1.3
Caputa loam, 0 to 2 percent slopes	24	32	18	24	24	32	1.3	1.8
Caputa loam, 2 to 6 percent slopes	22	29	15	21	23	30	1.2	1.6
Caputa loam, 6 to 9 percent slopes	17	25	12	17	20	27	1.0	1.4
Chinook fine sandy loam, 0 to 3 percent slopes	13	17	10	13	19	24	.9	1.2
Glenberg fine sandy loam, 0 to 2 percent slopes	15	21	8	11	23	29	1.2	1.7
Glenberg fine sandy loam, 2 to 6 percent slopes	14	20	7	10	22	28	1.1	1.6
Haverson loam, 0 to 2 percent slopes	23	29	13	16	26	36	1.4	1.9
Haverson loam, 2 to 6 percent slopes	22	28	11	14	25	34	1.3	1.4
Keith silt loam, 0 to 2 percent slopes	28	35	21	26	25	33	1.5	2.1
Keith silt loam, 2 to 6 percent slopes	26	33	20	25	24	32	1.4	2.0
Keith silt loam, 6 to 9 percent slopes	22	28	17	21	20	28	1.2	1.8
Kyle clay, 0 to 2 percent slopes	16	21	14	18	19	24	1.2	2.0
Kyle clay, 2 to 6 percent slopes	15	20	13	17	18	23	1.2	1.8
Kyle clay, terrace	16	21	14	18	19	24	1.2	2.0
Kyle-Pierre clays, 0 to 6 percent slopes	15	20	13	17	18	23	1.2	1.8
Lohmiller silty clay loam, 0 to 2 percent slopes	21	27	14	19	23	28	1.3	1.7
Lohmiller silty clay loam, 2 to 6 percent slopes	18	22	13	18	20	24	1.2	1.6
Manter fine sandy loam, 0 to 2 percent slopes	20	27	10	15	25	32	1.0	1.4
Manter fine sandy loam, 2 to 6 percent slopes	19	25	9	14	23	28	.9	1.3
Manvel silty clay loam, 0 to 2 percent slopes	16	20	10	15	17	21	.7	1.1
Manvel silty clay loam, 2 to 6 percent slopes	15	20	9	14	15	20	.6	.9
Mawer fine sandy loam, 0 to 2 percent slopes	15	22	10	14	18	23	.9	1.2
Mawer fine sandy loam, 2 to 6 percent slopes	14	21	9	11	17	21	.8	1.1
Minnequa silty clay loam, 2 to 6 percent slopes	13	19	8	12	14	18	.6	.8
Nevee silt loam, 2 to 6 percent slopes	17	24	9	14	19	24	.8	1.1
Oburn loam, 0 to 3 percent slopes	12	16	8	11	18	25	.6	.8
Parshall fine sandy loam, 0 to 3 percent slopes	15	21	12	17	24	30	1.0	1.6
Pierre clay, 2 to 6 percent slopes	13	17	10	14	15	20	.6	.9
Ralph loam, 3 to 6 percent slopes	18	26	13	20	26	32	.8	1.3
Razor silty clay loam, 0 to 2 percent slopes	15	20	9	13	15	20	.8	1.0
Razor silty clay loam, 2 to 6 percent slopes	14	19	8	12	14	18	.7	.9
Satanta loam, 0 to 2 percent slopes	24	30	17	24	24	30	1.4	1.8
Satanta loam, 2 to 6 percent slopes	21	29	16	22	23	29	1.3	1.7
Satanta loam, 6 to 9 percent slopes	18	26	14	20	20	25	1.1	1.5
Savo silty clay loam, 0 to 2 percent slopes	21	29	15	21	24	30	1.1	1.5
Savo silty clay loam, 2 to 6 percent slopes	18	28	14	20	23	29	1.0	1.4
Sorum fine sandy loam, 0 to 6 percent slopes	10	13	8	11	19	24	.8	1.0
Stetter clay					17	23	.9	1.3
Vale silt loam, 0 to 2 percent slopes	28	35	21	26	25	33	1.5	2.1
Whitelake fine sandy loam, 0 to 2 percent slopes					21	25	.7	.9

Figure 20.—**Irrigation on Manter soil. Water is pumped from the Belle Fourche River.**

Transporting the water from the source to the field is more efficient if concrete ditch lining and underground pipelines are used to reduce the loss of valuable water through seepage. These practices also reduce erosion of field ditches, eliminate weeds along ditches, and reduce potential drainage and salting problems.

The main considerations in managing irrigated soils in the county are managing water, controlling erosion and soil blowing, and maintaining or improving tilth, fertility, and organic-matter content.

The purpose of irrigation water management is to apply irrigation water in a manner that meets the moisture needs of the crop being grown without overirrigating. The amount of water and frequency of application are determined by the available water capacity of the soil and the moisture needs of a specific crop. In applying water, the rate and length of a run are determined by the water intake rate and the slope of the soil being irrigated.

Other means of improving water management on irrigated soils are land leveling to obtain more uniform distribution of the water application, drainage measures to remove excess water or to regulate the water table, and careful selection of the method of applying the irrigation water. In Butte County the methods commonly used to apply irrigation water are controlled flooding, furrows (fig. 21), borders, and sprinklers. Sprinkler irrigation is particularly suited to soils that have a rapid water intake rate or are unsuitable for land leveling because they are undulating or are shallow over gravel or bedrock.

Properties and features of soils that affect irrigation are shown in tables 5 and 6 of this survey. Further information on and assistance in the design and operation of irrigation systems can be obtained from the local office of the Soil Conservation Service.

Practices that help control erosion on irrigated soils are careful application of water at rates and in irrigation runs that prevent excessive erosion, use of contour ditches, bench leveling, management of crop residue, and use of close-sown crops on sloping soils. Contour stripcropping helps control erosion on gently sloping soils that are irrigated by sprinklers.

Some irrigated soils in Butte County are subject to soil blowing. Practices that help control soil blowing are management of crop residue, use of cover crops, wind stripcropping, and field windbreaks.

Practices that maintain or improve tilth, organic-matter content, and fertility are management of crop residue, use of grasses and legumes in the cropping system, use of animal manure and green

Figure 21.—Furrow irrigation on Glenberg fine sandy loam, 0 to 2 percent slopes.

manure crops, and minimum tillage. Also, timely tillage is important on clayey soils, such as Kyle soils.

Many irrigated soils in the county have low natural fertility. Annual applications of commercial fertilizers are needed to fully realize the benefits of the additional moisture supplied by irrigation. The amount and kind of fertilizer depend on the kind of soil and the kind of crop to be grown. They can be determined by soil tests. Information about soil tests and fertilizer can be obtained from the office of the county agricultural extension agent.

Management by irrigated capability units

In the following paragraphs, each irrigated capability unit in Butte County is described and suggestions for use and management are given. Climatic limitations are alleviated as a result of the availability of irrigation water, but some other characteristics and properties of the soils are more critical to management than under dryfarmed conditions. As a result, irrigated soils are assigned to different capability units from those to which the soils are assigned under dryland conditions.

The names of the soil series represented in each irrigated capability unit are mentioned in the description, but this does not mean that all the soils in a given series are in that unit. Only those soils suitable for irrigation that are currently irrigated are listed. The irrigated capability units for these soils are given in the Guide to Mapping Units.

CAPABILITY UNIT I-1 IRRIGATED

This unit consists of deep, nearly level silty soils of the Lohmiller and Manvel series. These soils formed in calcareous material. The surface layer and underlying material are silty clay loam. In many places the underlying material is thinly stratified with finer textured or coarser textured material.

Fertility is low, and available water capacity is moderate or high. The moisture holding zone is 4 feet or more. Water intake is slow, and permeability is slow or moderately slow.

These soils are well suited to all irrigated crops commonly grown in the county. Alfalfa is the main crop. Corn, edible beans, barley, and oats also are grown.

Improving fertility, managing irrigation water, and controlling soil blowing are the main concerns in management. Commercial fertilizer and animal manure improve fertility. In many areas land level-

ing improves water management. Managing crop residue helps control soil blowing. Wind stripcropping and field windbreaks are desirable in some areas.

CAPABILITY UNIT I-2 IRRIGATED

This unit consists of deep, nearly level silty and loamy soils of the Keith, Satanta, and Vale series. These soils have a surface layer of silt loam or loam and a subsoil of silt loam, clay loam, or silty clay loam.

These soils are easy to work and have medium fertility. Available water capacity is high, and permeability is moderate. The moisture holding zone is 4 feet or more. Water intake is moderately slow.

These soils are well suited to all irrigated crops commonly grown in the county. Corn, alfalfa, barley, oats, and edible beans are the main crops.

Maintaining fertility and managing water are the main concerns in management. Management of crop residue, use of commercial fertilizer and animal manure, and use of legumes in the cropping system maintain fertility. In many areas land leveling improves water management. However, the cut areas have poorer tilth than the original soil because the subsoil contains more clay.

CAPABILITY UNIT I-3 IRRIGATED

This unit consists of deep, nearly level, calcareous silty and loamy soils of the Barnum and Haverson series. These soils have a surface layer of silt loam or loam and an underlying layer of silty or loamy alluvium. The alluvium commonly is thinly stratified with finer textured or coarser textured material.

These soils have low fertility and are easy to work. Available water capacity is high, and permeability is moderate. The moisture holding zone is 5 feet or more. Water intake is moderate. Soil blowing is a hazard in some areas.

These soils are well suited to all the irrigated crops commonly grown in the county. Corn, alfalfa, barley, oats, and edible beans are the main crops.

Managing water and improving fertility and organic-matter content are the main concerns in management. In many areas land leveling improves water management. Commercial fertilizer, animal manure, and legumes in the cropping system improve fertility and organic-matter content. Management of crop residue helps control soil blowing.

CAPABILITY UNIT IIe-1 IRRIGATED

Manter fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is a deep soil that has a surface layer and subsoil of fine sandy loam.

This soil has medium fertility and is easy to work. Available water capacity is moderate or high, and permeability is moderately rapid. The moisture holding zone is 4 feet or more. Water intake is moderately rapid.

This soil is well suited to all the irrigated crops commonly grown in the county. Corn, edible beans, and alfalfa are the main crops. Barley and oats also are grown.

Controlling soil blowing, managing water, and maintaining fertility and organic-matter content are the main concerns in management. Managing crop residue, wind stripcropping, and using field windbreaks help control soil blowing. Land leveling where needed improves water management. Commercial fertilizer, animal manure, and legumes in the cropping system maintain or improve fertility and organic-matter content.

CAPABILITY UNIT IIe-2 IRRIGATED

Mawer fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is underlain by sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. It blows easily. Available water capacity is low. Water intake is moderately rapid, but the underlying sand and gravel holds very little moisture.

This soil is suited to most irrigated crops commonly grown in the county. Corn, edible beans, and alfalfa are the main crops. Barley and oats also are grown.

Controlling soil blowing, managing water, and maintaining or improving fertility and organic-matter content are the main concerns in management. Managing crop residue and wind stripcropping help control soil blowing. Land leveling where needed improves water management; however, deep cuts that expose the underlying sand and gravel reduce the suitability of the soil for irrigation. Commercial fertilizer, animal manure, and legumes in the cropping system maintain or improve fertility and organic-matter content.

CAPABILITY UNIT IIe-3 IRRIGATED

Glenberg fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is calcareous. It is fine sandy loam to a depth of 35 inches and loamy sand below.

This soil is easy to work but has low fertility. It blows easily. Available water capacity is moderate, and permeability is moderately rapid. The moisture holding zone is 5 feet or more. Water intake is moderately rapid.

This soil is suited to all the irrigated crops commonly grown in the county. Alfalfa, corn, edible beans, and barley are the main crops. Oats also is grown.

Controlling soil blowing, managing water, and improving fertility and organic-matter content are concerns in management. Managing crop residue helps control soil blowing. Land leveling where needed improves water management (fig. 22). Commercial fertilizer, animal manure, green manure crops, and legumes in the cropping system improve fertility and organic-matter content.

CAPABILITY UNIT IIs-1 IRRIGATED

This unit consists of deep, nearly level silty soils of the Baca and Savo series. These soils have a surface layer of silty clay loam and a subsoil of silty clay loam or silty clay.

These soils easily lose their tilth when in cultivation. Available water capacity is moderate or high, and permeability is slow or moderately slow. The

Figure 22.—Land leveling on Glenberg fine sandy loam, 0 to 2 percent slopes.

moisture holding zone is 4 feet or more. Water intake is slow.

Alfalfa, corn, oats, and barley are suitable crops.

Improving tilth, fertility, and organic-matter content; managing water; and controlling soil blowing are concerns in management. Legumes in the cropping system, animal manure, and crop residue improve tilth, organic-matter content, and water intake. Commercial fertilizer helps improve fertility. Land leveling where needed distributes irrigation water more uniformly, but tilth is affected where cuts expose the more clayey subsoil.

CAPABILITY UNIT IIs-2 IRRIGATED

Altvan loam, 0 to 2 percent slopes, is the only soil in this unit. It has a subsoil of clay loam and an underlying layer of sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. Available water capacity is low or moderate. Water intake is moderate, but the underlying sand and gravel holds a limited amount of moisture. The root zone is limited.

Alfalfa and corn are the main irrigated crops, but oats and barley also are suitable.

Managing water and maintaining fertility and organic-matter content are the main concerns in management. Land leveling where needed distributes irrigation water more evenly, but suitability of the soil is seriously affected where deep cuts expose the underlying sand and gravel. Commercial fertilizer, animal manure, legumes in the cropping system, and crop residue maintain fertility and organic-matter content.

CAPABILITY UNIT IIIe-1 IRRIGATED

This unit consists of deep, gently sloping silty soils of the Baca, Lohmiller, Manvel, and Savo series. These soils have a surface layer of silty clay loam and an underlying layer of silty clay loam or silty clay.

Fertility is low or medium, and the soils lose their tilth easily when cultivated. Available water capacity is moderate or high, and permeability is slow or moderately slow. Water intake is slow. Runoff is medium.

Alfalfa and small grain are the main crops and are better suited than corn.

Controlling erosion and soil blowing, managing water, and improving tilth and fertility are concerns

in management. Using close-growing crops, managing crop residue, and holding length of irrigation runs to recommended limits help control erosion and soil blowing. Land leveling, including bench leveling, improves water management. Legumes in the cropping system and animal manure improve tilth and, along with commercial fertilizers, improve fertility.

CAPABILITY UNIT IIIe-2 IRRIGATED

This unit consists of deep, gently sloping silty and loamy soils of the Keith and Satanta soils. These soils have a surface layer of silt loam or loam and a subsoil of silt loam or clay loam.

These soils are easy to work and have medium fertility. Available water capacity is high, and permeability is moderate. The moisture holding zone is 4 feet or more. Water intake is moderately slow. Runoff is medium.

Alfalfa and small grain are the main crops and are better suited than row crops. Corn and edible beans are grown in some areas.

Controlling erosion, managing water, and maintaining fertility are the main concerns in management. Managing crop residue, using close-growing crops, and limiting irrigation runs to those recommended for these soils help control erosion. Land leveling improves water management. Bench leveling is a form of land leveling that is adapted to these soils. Commercial fertilizer, animal manure, and legumes in the cropping system maintain fertility.

CAPABILITY UNIT IIIe-3 IRRIGATED

This unit consists of deep, gently sloping loamy and silty soils of the Haverson and Nevee series. These soils formed in calcareous loamy and silty material.

These soils are easy to work but have low fertility. Available water capacity is moderate or high, and permeability is moderate. Erosion and soil blowing are hazards. The moisture holding zone is 4 feet or more. Water intake is moderate.

Alfalfa is the main crop, but corn and small grain also are grown. Close-sown crops are better suited than row crops.

Controlling erosion and soil blowing, managing water, and improving fertility and organic-matter content are the main concerns in management. Managing crop residue, using close-growing crops, and limiting irrigation runs to those recommended for these soils help control erosion. Bench leveling is a form of land leveling that works well on these soils and improves water management. Commercial fertilizer, animal manure, and legumes in the cropping system improve fertility.

CAPABILITY UNIT IIIe-4 IRRIGATED

This unit consists of deep, gently sloping loamy soils of the Alice, Glenberg, and Manter series. These soils have a surface layer of fine sandy loam and an underlying layer of fine sandy loam. Loamy sand is at a depth of 35 inches in the Glenberg soil.

These soils are easy to work and have medium or low fertility. Permeability is moderately rapid, and available water capacity is moderate or high. The moisture holding zone is 5 feet or more. Water intake is moderate in the Manter soil and moderately rapid in the rest. All the soils are subject to soil blowing. The hazard of water erosion is slight.

Alfalfa, small grain, and corn are the main crops. Close-sown crops are better suited than corn.

Controlling soil blowing and erosion, managing water, and maintaining or improving fertility and organic-matter content are all concerns in management. Managing crop residue and using field windbreaks help control soil blowing. Using close-sown crops and limiting the length of irrigation runs to those recommended for these soils help control water erosion. Bench leveling is one of the kinds of land leveling that improves water management. Commercial fertilizer, animal manure, green-manure crops, and legumes in the cropping system maintain or improve fertility and organic-matter content.

CAPABILITY UNIT IIIes-1 IRRIGATED

Altvan loam, 2 to 6 percent slopes, the only soil in this unit, is a loamy soil. It has a subsoil of clay loam and an underlying layer of sand and gravel at a depth of 20 to 40 inches.

This soil is easy to work and has medium fertility. Available water capacity is low or moderate. Water intake is moderate, but only a limited amount of moisture is held in the underlying sand and gravel. Runoff is medium.

Alfalfa and corn are the main irrigated crops. Close-sown crops, such as alfalfa and small grain, are better suited than corn.

Controlling erosion, managing water, and maintaining fertility are the main concerns in management. Managing crop residue and limiting the length of the irrigation run to that recommended for this soil help control erosion and also improve water management. Land leveling is feasible only in those areas where cuts are limited to less than 10 inches. Commercial fertilizer, animal manure, and legumes in the cropping system maintain fertility.

CAPABILITY UNIT IIIs-1 IRRIGATED

This unit consists of deep, nearly level, clayey soils of the Kyle and Stetter series. These soils are clay throughout.

The soils are difficult to work and have low fertility. Available water capacity is low or moderate, and permeability is very slow or slow. The moisture holding zone is 4 feet or more. Water intake is very slow. The clayey texture restricts root development. The Stetter soil is subject to flooding in some years, and the Kyle soil blows easily.

Alfalfa is the main irrigated crop. Corn and small grain are grown in some areas.

Improving tilth and fertility, managing water, and controlling soil blowing are concerns in management. Minimum tillage, crop residue, grasses and legumes in the cropping system, animal manure, and commercial fertilizer improve tilth and fertility and also help control blowing. Land leveling where needed improves water management.

CAPABILITY UNIT IVes-1 IRRIGATED

Kyle clay, 2 to 6 percent slopes, the only soil in this unit, is a deep soil that is clay throughout.

This soil is difficult to work and has low fertility. Available water capacity is low or moderate, and permeability is very slow. The moisture holding zone is 4 feet or more. Water intake is very slow. The clay texture restricts development of plant roots. Runoff is medium, and erosion and soil blowing are hazards.

Alfalfa is the main irrigated crop. Small grain and tame grasses also are grown.

Controlling erosion and soil blowing, improving tilth and fertility, and managing water are concerns in management. Limiting the length of irrigation runs to those recommended for this soil, using close-sown crops, and managing crop residue help control erosion and soil blowing. Minimum tillage, grasses and legumes in the cropping system, animal manure, and commercial fertilizer improve tilth and fertility. Bench leveling is one of the kinds of land leveling that improves water management.

CAPABILITY UNIT IVes-2 IRRIGATED

This unit consists of moderately deep, nearly level and gently sloping silty soils of the Minnequa and Razor series. These soils have a surface layer and subsoil of silty clay loam and an underlying layer of shale and limestone at a depth of 20 to 40 inches. They are calcareous at or near the surface.

These soils have low fertility. Available water capacity is low, and permeability is moderately slow or slow. The moisture holding zone and root zone are less than 40 inches deep. Water intake is moderately slow or slow. Runoff is slow or medium.

Alfalfa is the main irrigated crop. Some small grain and corn also are grown.

Controlling soil blowing and erosion; improving fertility, organic-matter content, and tilth; and managing water are concerns in management. Managing crop residue, using close-sown crops, and limiting the length of irrigation runs to that recommended for these soils help control soil blowing and water erosion. Commercial fertilizer, animal manure, and grasses and legumes in the cropping system improve fertility, organic-matter content, and tilth. The soils are not suited to land leveling in most areas, but in places land smoothing helps distribute irrigation water more uniformly.

CAPABILITY UNIT IVes-3 IRRIGATED

Mawer fine sandy loam, 2 to 6 percent slopes, the only soil in this unit, is 20 to 40 inches deep over sand and gravel.

This soil is easy to work and has medium fertility. It blows easily and to some extent is subject to water erosion. Water intake is moderately rapid. Available water capacity is low, and permeability is rapid in the underlying sand and gravel.

Alfalfa and corn are the main irrigated crops. Small grain also is grown and is better suited than corn.

Controlling soil blowing and erosion, managing irrigation water, and maintaining fertility and organic-matter content are concerns in management. Crop residue management, use of close-sown crops, and limiting irrigation runs to a suitable length help control erosion and soil blowing. Land leveling is a suitable water management practice only if cuts are limited to less than 10 inches. Commercial fertilizer, animal manure, and grasses and legumes in the cropping system maintain fertility and organic-matter content.

CAPABILITY UNIT IVes-4 IRRIGATED

Whitelake fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is a deep soil. It has a claypan subsoil of fine sandy loam and sandy loam that is very hard when dry.

This soil is easy to work and has medium fertility. Water intake initially is moderately rapid, but the slow permeability of the claypan subsoil reduces it to a slow rate after the surface layer is saturated. Available water capacity is low.

Alfalfa is the main irrigated crop, but small grain and corn also are grown.

Controlling soil blowing, managing water, improving water intake, and maintaining fertility and organic-matter content are concerns in management. Crop residue management and close-sown crops help control soil blowing. Legumes in the cropping system improve water intake in the subsoil. Land leveling is not recommended because the soil has a claypan subsoil; however, land smoothing helps distribute irrigation water more uniformly and reduces ponding in low spots. Commercial fertilizer and animal manure maintain fertility and organic-matter content.

CAPABILITY UNIT IVse-1 IRRIGATED

Dix sandy loam, 0 to 3 percent slopes, the only soil in this unit, is underlain by gravel and sand at a depth of 10 to 20 inches.

This soil is easy to work and has medium fertility. Available water capacity is low, and permeability is rapid in the underlying sand and gravel. Water intake is rapid.

Alfalfa, small grain, and corn are the main irrigated crops. Small grain is better suited than corn.

Managing water, controlling soil blowing, and maintaining fertility are the main concerns in management. Land leveling is not feasible on this soil because gravel is at a shallow depth, but in some areas land smoothing helps distribute irrigation water more uniformly. Crop residue management and close-sown crops help control soil blowing. Commercial fertilizer, animal manure, and grasses and legumes in the cropping system maintain fertility and organic-matter content.

Predicted yields of irrigated crops

Table 3 gives predicted long-term average yields per acre for the principal irrigated crops grown in the county. The yields shown are for two levels of management.

The yields shown in columns A can be expected under the level of management commonly practiced in the county. Under this kind of management, irrigated land is leveled if feasible. Water losses on

TABLE 3.—*Predicted average yields per acre of principal irrigated crops under two levels of management*

[Figures in columns A indicate yields under average management; figures in columns B indicate yields under improved management. Only soils suitable for irrigation are listed. Absence of a figure indicates that the crop is not commonly grown on the soil specified]

Soil	Alfalfa		Corn		Edible beans		Barley		Oats	
	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*
Alice fine sandy loam, 2 to 6 percent slopes	2.8	4.0	35	70			20	45	30	60
Altvan loam, 0 to 2 percent slopes	3.1	4.5	40	80	25	40	23	30	40	70
Altvan loam, 2 to 6 percent slopes	2.5	3.8	35	70			22	27	35	60
Baca silty clay loam, 0 to 2 percent slopes	3.0	4.2	40	80	25	40	23	30	40	70
Baca silty clay loam, 2 to 6 percent slopes	2.5	3.8	35	70			22	27	35	60
Barnum silt loam	3.5	5.0	50	90	30	45	35	50	45	80
Dix sandy loam, 0 to 3 percent slopes	2.0	3.0	30	60	20	30	25	35	30	60
Glenberg fine sandy loam, 0 to 2 percent slopes	3.0	5.0	40	90	25	45	30	50	40	80
Glenberg fine sandy loam, 2 to 6 percent slopes	2.8	4.0	35	80			20	45	30	60
Haverson loam, 0 to 2 percent slopes	3.5	5.0	50	90	30	45	35	50	45	80
Haverson loam, 2 to 6 percent slopes	3.0	4.0	35	80			25	45	35	60
Keith silt loam, 0 to 2 percent slopes	3.5	5.0	50	90	30	45	35	50	45	80
Keith silt loam, 2 to 6 percent slopes	3.0	4.0	40	80			25	45	35	60
Kyle clay, 0 to 2 percent slopes	1.8	3.2	25	60			18	32	35	65
Kyle clay, 2 to 6 percent slopes	1.5	2.8	20	50			14	22	27	50
Kyle clay, terrace	1.8	3.2	25	60			18	32	35	65
Lohmiller silty clay loam, 0 to 2 percent slopes	3.0	4.0	45	75	25	40	32	45	40	75
Lohmiller silty clay loam, 2 to 6 percent slopes	2.5	3.5	40	65			23	40	35	60
Manter fine sandy loam, 0 to 2 percent slopes	3.2	5.0	45	90	27	45	35	50	45	80
Manter fine sandy loam, 2 to 6 percent slopes	2.8	4.0	35	65			20	45	30	60
Manvel silty clay loam, 0 to 2 percent slopes	2.5	3.7	40	70	22	38	30	40	40	70
Manvel silty clay loam, 2 to 6 percent slopes	2.4	3.2	35	60			23	38	35	60
Mawer fine sandy loam, 0 to 2 percent slopes	3.1	4.5	40	80	25	40	30	40	40	70
Mawer fine sandy loam, 2 to 6 percent slopes	2.5	3.8	35	70			27	35	35	60
Minnequa silty clay loam, 2 to 6 percent slopes	1.8	3.0	25	45			15	25	30	60
Nevee silt loam, 2 to 6 percent slopes	3.0	4.0	35	65			30	45	35	60
Razor silty clay loam, 0 to 2 percent slopes	2.0	3.5	30	65			20	35	40	70
Razor silty clay loam, 2 to 6 percent slopes	1.8	3.0	25	45			15	25	30	60
Satanta loam, 0 to 2 percent slopes	3.5	5.0	50	85	30	45	33	48	45	75
Satanta loam, 2 to 6 percent slopes	3.0	4.0	40	80			24	43	35	55
Savo silty clay loam, 0 to 2 percent slopes	3.2	4.8	45	80	25	40	30	45	40	70
Savo silty clay loam, 2 to 6 percent slopes	2.8	3.8	35	60			25	40	32	55
Stetter clay	1.8	3.0	25	45			15	25	30	60
Vale silt loam, 0 to 2 percent slopes	3.5	5.0	50	90	30	45	35	50	45	80
Whitelake fine sandy loam, 0 to 2 percent slopes	2.8	4.2	35	70	20	30	25	35	35	60

the farms are caused by seepage from ditches, overirrigation of crops, or application of water in excess of the intake rate of the soil. The use of wild flooding on close-sown crops, the excessive length of runs, and the failure to properly time irrigation to meet crop needs result in inefficient water use. In contour ditch systems commonly used on land too steep for leveling, the ditches in many places are spaced too far apart for good distribution of water. The cropping system is commonly a year of row crops and 4 or 5 years of alfalfa. Crop residue is returned to the soil. Feedlot manure is utilized on the fields, and some commercial fertilizer is also used as available funds permit.

The yields shown in columns B can be expected under improved management, using an efficient and economical cropping system. Under this kind of management, a planned system to achieve maximum water control is used. Land is leveled if feasible. Water losses and erosion are reduced by the use of ditch lining, underground pipelines, and control structures. The size of streams is adjusted to achieve proper water penetration and avoid water loss and erosion. The length of irrigation runs is adjusted, according to the soil and crop, for the most efficient water use. Borders are used for close-sown crops, and ditches in contour ditch systems are spaced close enough to achieve uniform water distribution. Surface drainage is provided to prevent ponding. Frequency of irrigation is timed closely to the needs of the crop. The cropping system commonly includes row crops and alfalfa, and alfalfa is maintained 3 to 5 years in a rotation. Alfalfa is used more intensively on the finer textured soils. Crop residue is utilized to control erosion during winter by leaving stubble standing or by controlling grazing of crop aftermath. Fertilization at relatively high levels, according to soil tests, is practiced. Improved crop varieties, high-quality seed, and controlled planting rates are used for maximum crop production. Pesticides and herbicides are used to control weeds and insects.

Management of irrigated tame pasture[6]

Irrigated pasture makes up a small but important acreage in Butte County. It can be used to supplement and balance the production of livestock feed

[6] By PAUL M. BODEN, conservation agronomist, Soil Conservation Service.

and forage produced by other parts of the irrigated farm. In some areas it is used to supplement summer grazing provided by the parts of the county used for range.

The soils of many irrigated pastures in the county are irregular in slope or are moderately deep over clay shale. Some areas have been left in native grass, and others are seeded to tame grasses. Flood irrigation from contour ditches is the common method of irrigation on sloping soils. The border method of applying water is used on nearly level soils.

The objective in managing irrigated pasture is to obtain the greatest return in forage production yet avoid deterioration of the soil from excessive use of water or from erosion. Using good irrigation water management and chemical fertilizers as needed, together with good pasture management, are important.

Good pasture management means grazing the pasture in accordance with the amount of forage produced. Best results are obtained if livestock are withheld from the pasture until a specific height of growth is reached, depending on the kinds of grass in the pasture. This also allows the surface layer to dry and helps prevent soil compaction by livestock. On irrigated pasture, rotation grazing generally is needed for proper use of the pasture. Other measures that help meet management objectives are clipping to encourage uniform grazing, controlling weeds, and reseeding to adapted grasses to improve the stand.

Sudangrass hybrids are suitable in many grazing systems, but perennial grasses are desirable for permanent pasture plantings. Bunch grasses generally are unsuitable for sloping soils unless sod-forming grasses are planted. Additional information about irrigated pasture can be obtained from the local office of the Soil Conservation Service and from the county agricultural extension agent.

In the following paragraphs the soils of Butte County are grouped according to their suitability for irrigated pasture. The names of the series represented are mentioned in each group, but this does not mean all the soils of a given series are in that group. Only those soils suitable for irrigated tame pasture are included.

IRRIGATED PASTURE GROUP I

This group consists of deep, well-drained silty and loamy soils of the Barnum, Haverson, Keith, Lohmiller, Manvel, Nevee, Satanta, Savo, and Vale series. Water intake is moderate to slow. Available water capacity is moderate or high. The root zone and the availability of moisture are favorable for deep-rooted plants. Reaction ranges from slightly acid to moderately alkaline.

Creeping foxtail, smooth bromegrass, orchardgrass, intermediate wheatgrass, tall fescue, alfalfa, Ladino clover, and sweetclover are suitable grasses and legumes. Reed canarygrass and switchgrass can be used in seep spots.

IRRIGATED PASTURE GROUP II

This group consists of deep, well-drained loamy soils of the Alice, Glenberg, and Manter series. These soils are fine sandy loam. They formed in moderately sandy material. Available water capacity is moderate or high, and the soils give up water readily for plant use. Reaction ranges from slightly acid to mildly alkaline. Water intake is moderate in the Manter soil and moderately rapid in the rest.

Smooth bromegrass, crested wheatgrass, orchardgrass, intermediate wheatgrass, alfalfa, Ladino clover, and sweetclover are suitable grasses and legumes. Switchgrass can be used for warm-season pasture.

IRRIGATED PASTURE GROUP III

This group consists of deep and moderately deep, well-drained silty and clayey soils of the Baca, Kyle, Minnequa, and Razor series. Water intake is moderately slow in the Minnequa soil and slow or very slow in the rest. Available water capacity is moderate or high in the Baca soil and low or moderate in the rest. Moisture is relased slowly to plants.

Crested wheatgrass, western wheatgrass, smooth bromegrass, alfalfa, and sweetclover are suitable grasses and legumes.

IRRIGATED PASTURE GROUP IV

This group consists of well-drained and somewhat excessively drained soils of the Altvan, Dix, and Mawer series. Gravel and sand are at a depth of 10 to 20 inches in the Dix soil and 20 to 40 inches in the rest. Water intake is moderate in the Altvan soil and rapid in the rest. Available water capacity is low or moderate in the Altvan soil and low in the rest. Land leveling is not feasible in many areas of these soils, and managing irrigation water is difficult. Rapid water intake in the Dix and Mawer soils limits the size of areas to be flooded or bordered.

Crested wheatgrass, orchardgrass, smooth bromegrass, intermediate wheatgrass, alfalfa, Ladino clover, and sweetclover are suitable grasses and legumes. Switchgrass also is suited to Altvan and Mawer soils.

Woodland and Windbreaks[7]

The natural woodlands in Butte County are mainly scattered stands of ponderosa pine and bur oak. These stands are considered to be foothills-type forest vegetation and are concentrated in about 30,000 acres in the southwestern part of the county. Stringers and clumps of other native trees grow along the major streams and their tributaries.

Only about 2,000 acres are true forest type vegetation. These stands are on Lakoa soils, which are mainly in covelike positions at the heads of drainageways or on the steep, north- and west-facing sides of ridges and ravines. On this soil, ponderosa pine, the main species, grows to mature heights of 45 to 65 feet. The understory is mid grasses and sedges. These areas are used mainly for grazing and for wildlife habitat, but they have potential for producing sawlogs, pulpwood, and fenceposts.

[7] By ELMER L. WORTHINGTON, woodland conservationist, Soil Conservation Service.

Figure 23.—Top: Savanna type cover on Snomo soil in Snomo-Shale land complex, 3 to 25 percent slopes. *Bottom:* Thin stand of ponderosa pine and bur oak on Shale land.

The rest of the foothills-type vegetation is savanna of mostly grass and scattered small stands or clumps of ponderosa pine (fig. 23) or bur oak. Many areas of this type of cover are on Snomo soils in the Clay Savannah range site. Some areas are mostly ponderosa pine, some are bur oak, and some contain both species. Other soils that have a savanna type of cover in places are Butche, Canyon, Colby, and Spearfish soils. Also, some areas of Shale land have ponderosa pine and bur oak growing singly or in clumps. The ponderosa pines in the savanna areas are mostly short and limby and have a mature height of 40 feet or less. The average height of the bur oak is about 15 feet. These areas are used mostly for grazing and as wildlife habitat and a source of fenceposts.

Other native trees and shrubs in the county are on bottom land. The trees are green ash, cottonwood, willow, American elm, and boxelder. The shrubs are chokecherry, plum, and other minor species.

The natural woodlands in Butte County provide wildlife habitat, protection for livestock, and watershed protection. They are some of the more scenic parts of the county and have a potential for park and recreation development.

The main reason for planting trees in Butte County is to establish windbreaks for the protection of fields, farmsteads, and feedlots. A well-tended windbreak also is attractive and improves the esthetic setting of a farm or ranch. Windbreaks cover about 300 acres of the county. Additional windbreaks are needed to help keep yards free of snow, to protect livestock and buildings, to help control soil blowing, and to conserve moisture. Also, many existing windbreaks need supplemental plantings to make them more effective.

Farmstead and feedlot windbreaks are narrow belts of trees designed to protect yards, lots, buildings, and livestock from the effects of wind. A minimum of five to seven rows, including two rows of conifers, is needed for adequate protection.

Field windbreaks are strips or belts of trees and shrubs within or around a field. They can be one-row or multirow plantings and are particularly needed on intensively farmed irrigated soils if crop residue is light after harvest. They also are important on soils that blow easily, such as Alice and Manter soils.

Windbreak planting sites need careful preparation, and the trees planted need protection from fire, insects, disease, and grazing. Contour plantings on sloping soils help control erosion and also conserve moisture. Additional information about the establishment and care of trees can be obtained from the local office of the Soil Conservation Service.

To assist in planning and establishing windbreaks, the soils of Butte County are placed in windbreak groups. Table 4 lists the species best suited to each windbreak group and their performance on soils of that group. Tree heights listed are based on measurements and observations of windbreaks that are at least 20 years old and have received adequate care. The criteria that determine the condition class of each species in a group follow. One or more of the following apply:

Good.—Leaves or needles are normal in growth; only small amounts of dead wood are within the live crown; little or no disease, insect, and climatic damage is evident; only slight suppression or stagnation is apparent.

Fair.—Leaves or needles are abnormal in color and growth; substantial amounts of dead wood are within the live crowns; moderate disease, insect, or climate damage is obvious; definite suppression or stagnation is apparent; current year's growth is less than normal.

Poor.—Leaves or needles are very abnormal in color and growth; very large amounts of dead wood are within the live crowns; extensive disease, insect, or climate damage is obvious; severe stagnation, suppression, or decadence is apparent; current year's growth is negligible.

In the following paragraphs, the windbreak groups are described. Except for group 10, the description of each group gives the names of the soil series in that group; this does not mean that all the soils of a given series are in that group. To find the windbreak group of a given soil, refer to the "Guide to Mapping Units."

WINDBREAK GROUP 1

This group consists of deep, well-drained silty and loamy soils of the Barnum, Haverson, Lohmiller, and Parshall series. These soils receive additional moisture from flooding or in the form of runoff from adjacent soils. Available water capacity is moderate or high. Permeability is moderate or moderately rapid in the Parshall soil and moderate to slow in the rest. These soils have root zones and moisture regimes favorable for tree growth. There is some risk of soil blowing.

These soils are well suited to farmstead, feedlot, and field windbreaks. They also are well suited to recreation and wildlife plantings. A year of fallow generally is not necessary to prepare the site for planting.

WINDBREAK GROUP 2

This group consists of deep, well-drained, calcareous loamy soils of the Glenberg series. These soils are on bottom land and low terraces. They commonly receive additional moisture either from occasional flooding or in the form of runoff from adjacent soils. They have low fertility. Permeability is moderately rapid, and available water capacity is moderate. The moisture regime is favorable for tree growth, but the soil blows easily.

These soils are well suited to windbreaks of all kinds and to recreation and wildlife plantings. A year of fallow generally is not necessary to prepare the site for planting. Because soil blowing is a hazard, stubble or vegetation should be maintained between the rows and cultivation should be confined to the rows.

WINDBREAK GROUP 3

This group consists of deep and moderately deep,

well-drained silty and loamy soils of the Boneek, Caputa, Keith, Ralph, Satanta, Savo, and Vale series. These soils have medium fertility. Permeability is moderate or moderately slow, and available water capacity is moderate or high.

These soils are well suited to farmstead, feedlot, and field windbreaks. They also are suited to recreation and wildlife plantings. A year of fallow generally is a necessary part of site preparation except in irrigated areas.

WINDBREAK GROUP 4

This group consists of deep and moderately deep, well-drained silty and clayey soils of the Baca, Belfield, Bidman, Kyle, Pierre, Razor, and Stetter series. These soils have low or medium fertility. Permeability is slow or very slow. Available water capacity is moderate or high in the Baca, Belfield, and Bidman soils and moderate to very low in the rest. The clayey subsoil and underlying material release moisture slowly to plants and restrict root development.

These soils are moderately suited to windbreak planting. They also are suited to recreation and wildlife plantings where the height of growth is not a critical factor. A year of fallow is a necessary part of site preparation except in irrigated areas.

WINDBREAK GROUP 5

This group consists of deep, well drained and moderately well drained loamy soils of the Alice, Assinniboine, Chinook, Manter, Sorum, and Whitelake series. These soils have a surface layer of fine sandy loam. Fertility is low in the Sorum soil and medium in the rest. Permeability is very slow in the Sorum soil, slow in the Whitelake soil, and moderately rapid in the rest. Available water capacity is low in the Whitelake soil and moderate or high in the rest. Soil blowing is a severe hazard on all the soils.

These soils are well suited to tree plantings of all kinds, but soil blowing has to be controlled until the planting is established. Fall or spring site preparation is adequate. Liberal use of crop residue or a cover crop before and after planting helps control soil blowing until the trees are tall enough to provide protection.

WINDBREAK GROUP 6

This group consists of well-drained loamy soils of the Altvan and Mawer series. These soils are underlain by sand and gravel at a depth of 20 to 40 inches. They have medium fertility. They have low or moderate available water capacity and are somewhat droughty.

These soils are poorly suited to field windbreaks, farmstead and feedlot windbreaks, and recreation and wildlife plantings. They can be used for these purposes if optimum growth is not a critical factor. Fallow can be used in site preparation for the Altvan soil, but is hazardous on the Mawer soil because the risk of soil blowing is severe.

WINDBREAK GROUP 7

This group consists of deep, well-drained and excessively drained sandy soils of the Hanly and Zeona series. Fertility is low. Permeability is rapid, and available water capacity is low. Soil blowing is a severe hazard.

These soils are poorly suited to windbreak plantings. If carefully managed, they can be used for recreation, wildlife, and beautification plantings. Because the surface layer is unstable, site preparation is not considered desirable. Planting trees in scalp furrows helps control soil blowing.

WINDBREAK GROUP 8

This group consists of deep and moderately deep, well-drained, calcareous silty soils of the Minnequa, and Nevee series. These soils have low fertility. Permeability is moderately slow or moderate. Available water capacity ranges from low to high, but the high lime content of the soils has a detrimental effect on tree growth and limits the selection of species.

These soils are moderately well suited to windbreaks and wildlife and recreation plantings. The number of species is limited, and optimum response and growth generally do not occur. A year of fallow on the site stores moisture, but liberal use of crop residue is necessary to control soil blowing.

WINDBREAK GROUP 9

This group consists of soils of the Archin, Demar, and Oburn series. These soils have a surface layer of fine sandy loam and a claypan subsoil of sandy clay loam or clay loam. Salts commonly are in the lower part of the claypan or in the underlying material. These soils have low fertility. Permeability is very slow. Available water capacity is moderate, but the claypan releases moisture slowly and restricts root growth.

These soils are poorly suited to windbreak plantings. The number of suitable species is limited, and growth is less than that desired for windbreaks. These soils can be used for other plantings where growth and vigor are less critical.

WINDBREAK GROUP 10

This group consists of all soils that are not suited to windbreaks planted with machinery, but can be used for special type plantings by hand that are given special care. Some of the soils are not suited to windbreak planting because slopes, stoniness, or wetness prevent the use of machinery. Other soils in this group are shallow, contain salts, or have other characteristics that limit tree growth or survival.

Trees and shrubs selected for special type plantings, such as wildlife, recreation, or beautification, need to be tolerant of the soil limitations at the site. The special care needed for species survival commonly involves providing sufficient moisture to overcome low available water capacity.

Wildlife[8]

The kind and number of wildlife in a given area depend on the available habitat, which in turn

[8] By JOHN B. FARLEY, biologist, Soil Conservation Service.

TABLE 4.—*Estimated condition and height of trees and*

[Heights not given for

Windbreak groups	Trees											
	Black hills spruce		Boxelder		Colorado blue spruce		Cottonwood		Crabapple		Eastern redcedar	
	Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height
		Ft		*Ft*		*Ft*		*Ft*		*Ft*		*Ft*
Group 1	Good	20–24	Fair	15–17	Good	20–24	Fair	30–35	Good	12–14	Good	13–15
Group 2	Good	18–20	Fair	14–16	Good	18–20	Fair	28–30	Fair	11–13	Good	12–14
Group 3	Fair	17–19	Fair	15–17	Fair	17–19	Poor		Good	11–13	Good	10–12
Group 4	Poor		Poor		Poor		Poor		Fair	10–12	Good	13–15
Group 5	Poor		Poor		Poor		Poor		Fair	11–13	Good	11–13
Group 6	Poor		Poor		Poor		Poor		Poor		Fair	7– 9
Group 7	Poor		Poor		Poor		Poor		Poor		Fair	5– 7
Group 8	Poor		Poor		Poor		Poor		Poor		Fair	6– 8
Group 9	Poor		Poor		Poor		Poor		Poor		Fair	5– 7

Windbreak groups	Shrubs							
	Buffaloberry		Caragana		Chokecherry		Cotoneaster	
	Condition	Height	Condition	Height	Condition	Height	Condition	Height
		Ft		*Ft*		*Ft*		*Ft*
Group 1	Good	6–8	Good	8–10	Good	10–12	Good	4–5
Group 2	Fair	5–7	Good	7–9	Good	8–10	Good	4–5
Group 3	Fair	5–7	Good	8–9	Good	8–11	Good	4–5
Group 4	Good	5–7	Good	6–8	Good	8–10	Good	4–5
Group 5	Fair	5–6	Good	8–10	Fair	8–11	Good	4–5
Group 6	Poor		Fair	4–5	Poor		Poor	
Group 7	Poor		Poor		Poor		Poor	
Group 8	Fair	3–4	Fair	4–5	Poor		Poor	
Group 9	Fair	3–4	Fair	4–6	Poor		Poor	

depends on the kind of soil and its use and management. The soils in Butte County produce habitat that is attractive to many species of wildlife, including deer, antelope, pheasant, turkey, grouse, waterfowl, small mammals, snakes, and songbirds.

A given species of wildlife ordinarily requires a variety of habitat elements. Deer, for example, feed on grass and grain crops produced by Kyle soils and need the protective cover provided by Stetter soils on bottom land or by ravines in areas of Lismas and Pierre soils.

Five types of habitat are provided in Butte County. The location of each type on soil associations or parts of soil associations is shown in figure 24; also see the map showing soil associations at the back of this survey. The suitability of each type of habitat for specified kinds of wildlife is explained on the pages that follow.

WILDLIFE HABITAT TYPE 1

Habitat type 1 is on the Butche-Colby association and on most of the Grummit-Shale land and Caputa-Satanta associations. The areas consist of sloping to very steep ridges dissected by deeply entrenched canyons and ravines, gently sloping to steep shale uplands, and nearly level to sloping drainage divides and high terraces. This habitat type is on two distinct parts of the landscape: savanna and woodland and cultivated land. Much of it is in native vegetation and is used for grazing. Extensive areas of cropland are in the Caputa-Satanta association and also in scattered tracts of minor soils in the Butche-Colby association.

Savanna and woodland make up much of the Butche-Colby and Grummit-Shale land associations. The Lakoa soil in the Butche-Colby association has a true forest type cover, mainly ponderosa pine. The rest of the area consists of grassland and scattered trees, growing singly, in clumps, or in small stands. The species in these savanna areas are ponderosa pine and bur oak. Mid and short grasses are dominant in grassland areas, but big bluestem also occurs. Forbs and shrubs include chokecherry, currant, wild rose, western snowberry, fringed sagewort, snakeweed, western yarrow, yucca, leadplant, and rabbitbrush.

Year-long populations of white-tailed and mule deer are in savanna and woodland; turkeys are also common. Pheasants, mourning dove, sharptailed grouse, Hungarian partridge, and songbirds also are present. A few bobcats and bald eagles are in and around areas of Rock outcrop mapped in complex with some shallow soils.

Cultivated land is mainly in areas of Boneek,

shrubs at 20 years of age by windbreak group

species rated poor]

TREES

Golden willow		Green ash		Hackberry		Harbin pear		Ponderosa pine		Rocky Mountain juniper		Siberian elm	
Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height
	Ft		Ft		Ft		Ft		Ft		Ft		Ft
Good	28–32	Good	18–22	Good	16–18	Good	12–14	Good	20–24	Good	13–15	Good	25–30
Good	24–26	Good	16–18	Good	12–14	Good	10–12	Good	16–18	Good	12–14	Good	23–27
Poor		Good	14–16	Good	12–14	Good	11–13	Good	18–20	Good	10–12	Good	24–26
Poor		Good	14–16	Good	12–14	Fair	9–11	Good	15–17	Good	13–15	Good	23–25
Poor		Good	14–16	Good	16–18	Good	11–13	Good	18–20	Good	11–13	Good	22–24
Poor		Fair	9–11	Fair	11–13	Poor		Fair	11–13	Fair	7–9	Fair	11–13
Poor		Poor		Poor		Poor		Fair	12–14	Fair	6–8	Poor	
Poor		Fair	8–10	Poor		Fair	4–5	Fair	12–14	Fair	6–8	Fair	10–12
Poor		Fair	9–11	Poor		Fair	4–6	Fair	9–11	Fair	5–7	Fair	10–12

SHRUBS

Honeysuckle		Lilac		Nanking cherry		Plum		Russian-olive	
Condition	Height	Condition	Height	Condition	Height	Condition	Height	Condition	Height
	Ft		Ft		Ft		Ft		Ft
Good	6–8	Good	5–6	Fair	4–5	Good	7–8	Fair	14–16
Fair	5–7	Fair	4–5	Fair	4–5	Fair	4–5	Fair	12–14
Good	6–8	Good	6–7	Fair	4–5	Good	7–8	Fair	15–17
Fair	5–7	Good	4–5	Poor		Fair	4–5	Fair	12–14
Fair	4–6	Fair	4–5	Poor		Good	5–6	Fair	15–17
Poor		Fair	3–4	Poor		Poor		Fair	7–9
Poor		Poor		Poor		Poor		Poor	
Poor		Fair	3–4	Poor		Poor		Fair	8–9
Poor		Fair	3–4	Poor		Poor		Fair	8–9

Caputa, Keith, and Satanta soils. Wheat and alfalfa are the main crops. These areas supplement the nearby savanna and woodland and provide food for white-tailed and mule deer and turkeys. A moderate number of antelope lives on cultivated land west of Belle Fourche. Moderate numbers of pheasant and mourning dove and a few sharp-tailed grouse also are present.

Some livestock water ponds in the area are good warm-water fisheries and also provide excellent habitat for waterfowl.

WILDLIFE HABITAT TYPE 2

Habitat type 2 is on the Lohmiller-Glenberg-Haverson association and parts of the Pierre-Kyle, Midway-Penrose, and Caputa-Satanta associations. It includes the irrigated parts of the county, and much of it is cultivated. Alfalfa, corn, oats, barley, and edible beans are the main crops. Small areas of native grass are on isolated upland highs not reached by irrigation and on escarpments along the streams. Stringers and clumps of native trees and shrubs grow along stream channels. The native trees are mainly cottonwood, willow, green ash, and boxelder. The shrubs are chokecherry, currant, plum, buffaloberry, and rose. Included in this type are areas of Marsh.

The food and cover in this habitat type are excellent for pheasant. The cropland areas serve as feeding grounds for mallard ducks, which use the Belle Fourche Reservoir as a resting area. Ducks also use the small areas of Marsh. Shorebirds, such as long-billed curlew and killdeer, are common around the marshes and reservoirs, as are yellow-headed blackbirds and red-winged blackbirds. This habitat type also is favorable for deer, raccoon, mink, muskrat, beaver, mourning dove, and many species of songbirds. A few turkeys live along the Belle Fourche River west of the city of Belle Fourche.

The Belle Fourche Reservoir is a warm-water fishery stocked with walleye, channel catfish, and white bass. It also provides recreation in the form of boating and water skiing. The Belle Fourche River above its confluence with Whitewood Creek is a fishery where catfish species are dominant. Below this point the river is unsatisfactory as a fishery because it has a high silt load and other pollutants. The Redwater River is an excellent trout fishery.

WILDLIFE HABITAT TYPE 3

Habitat type 3 is on the Epsie association, on most parts of the Midway-Penrose and Arvada-Stetter associations, and on a few outlying parts of the Cabbart-Absher and Grummit-Shale land associa-

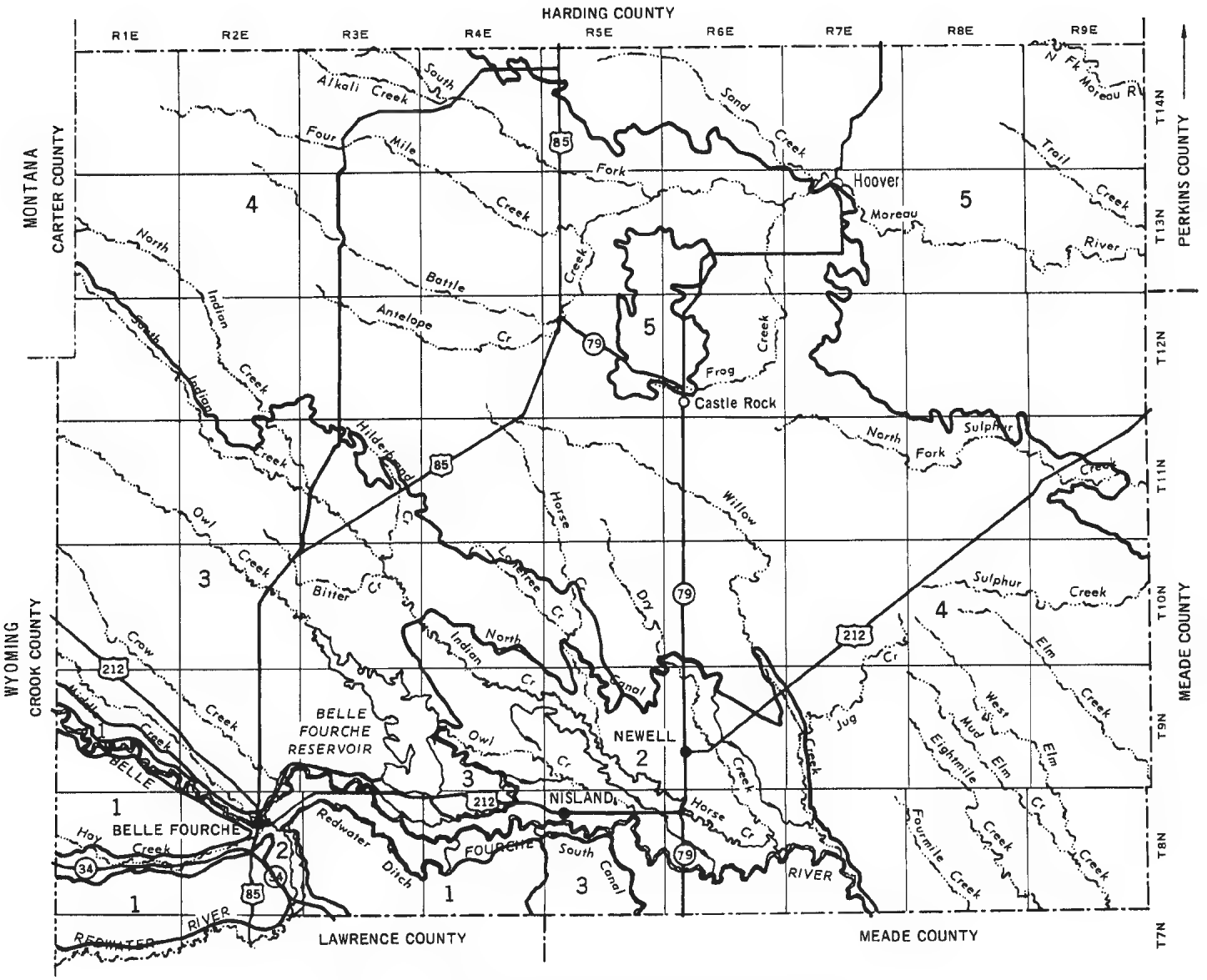

Figure 24.—**Location of five wildlife habitat types in Butte County.**

tions. It occurs on four distinct parts of the landscape: rough broken land, upland, bottom land, and claypan flats. Slickspots and Shale land, mapped with some soils in these associations, make up a considerable acreage. All parts are used almost entirely for range.

Rough broken land is mainly the Epsie association and the steeper ridges and deeply entrenched drainageways in the Grummit-Shale land association. Vegetation is sparse. It is chiefly Nuttall saltbush on the Epsie association and sparse stands of sedges and mid and tall saltbush on the Grummit-Shale land association. Shale land is barren or nearly barren of vegetation. Rough broken land provides cover and limited grazing for antelope and mule deer and habitat for a few bobcats. Some livestock ponds are excellent fisheries for largemouth black bass and bluegill.

Upland consists of the Midway-Penrose association and some of the less steep parts of the Grummit-Shale land association. Except for a few small tracts under cultivation, it is used for range. The vegetation on the Midway-Penrose association is mid and short grasses and an appreciable amount of low sagebrush. The upland provides excellent habitat for antelope and sage grouse. Jackrabbits and cottontails are common. Some of the larger ponds provide excellent fishing for largemouth black bass, bluegill, walleye, and northern pike. They also provide nesting and rearing habitat for ducks.

Bottom land consists of narrow strips of the nearly level Stetter soils along the larger creeks. It is used for range and hay. Western wheatgrass is the main grass. A few broadleaf trees grow along the stream channels. Bottom land provides habitat for mule deer and for fur-bearing animals, such as skunk, raccoon, and mink.

Claypan flats are nearly level valley flats and fans.

They consist of the claypan Absher, Arvada, and Demar soils; the clayey Broadhurst soils; and Slickspots. The vegetation is mostly mid and short grasses and a considerable amount of low sagebrush, greasewood, and pricklypear cactus. Claypan flats provide excellent habitat for sage grouse. Also, large numbers of antelope feed here. Jackrabbits and cottontails are numerous. Large prairie dog towns are on some areas of Arvada soils.

WILDLIFE HABITAT TYPE 4

Habitat type 4 is on the Winler-Lismas association and on most of the Pierre-Kyle association outside the irrigated parts of the county. About half of the county is in this type. It occurs on four distinct parts of the landscape: range, cultivated land, closed depressions, and bottom land. It is used for range, except for several dryfarmed tracts north of Arpan and east of Castle Rock.

Range is on uplands and stream terraces. The vegetation is chiefly western wheatgrass and Montana wheatgrass on the Winler-Lismas association, which includes many small areas of Slickspots that are barren or nearly barren of vegetation. On the Pierre-Kyle association, the vegetation is a mixture of mid and short grasses. Small amounts of low sagebrush are becoming increasingly more evident in the western part of the county. Range provides habitat for abundant numbers of antelope, sage grouse, jackrabbits, and cottontails in the western part of the county. The eastern part has significant numbers of antelope and rabbits, but only a few sage grouse. Mule deer are in the steeper parts along entrenched drainageways. The many surface water ponds are the main source of water for livestock. Some of the larger ponds are favorable fisheries for largemouth black bass and bluegill. The ponds also provide habitat for local and migratory ducks.

Cultivated land consists of tracts of Kyle and Pierre soils about 1,000 acres or more in size. Winter wheat is the main crop. Deer, mostly mule deer, feed in areas of cultivated land. Mourning dove and songbirds also are present. Cultivated land does not have the habitat cover, such as field windbreaks, to successfully protect a pheasant population during winter blizzards.

Closed depressions consist of McKenzie soils in upland depressions, mainly less than 30 acres in size. Water ponded in these depressions for short periods during spring attracts migratory waterfowl. In the wettest years, the depressions provide wetland habitat long enough to rear duck broods. In some years, however, the depressions remain dry.

Bottom land consists of Stetter soils along the upper reaches of the South Fork of Moreau River and along some of the larger creeks in habitat type 4. The areas are used for range and hay. The vegetation is mainly western wheatgrass and scattered broadleaf trees along some stream channels. These areas are habitat for mule deer. A few whitetailed deer also are in the areas. Also present are furbearing animals, such as raccoon, skunk, and mink. Newell Lake, a reservoir formed by an earth dam on Willow Creek, provides habitat for waterfowl and is an excellent fishery. It also is used for water skiing, boating, and swimming.

WILDLIFE HABITAT TYPE 5

Habitat type 5 is on the Twilight-Absher and Sorum associations, most areas of the Cabbart-Absher association, and parts of the Arvada-Stetter association. Topography ranges from nearly level bottom land, terraces, and upland flats to steep buttes and rough, broken areas along the sides of deeply entrenched streams and drainageways. This habitat type occurs on four distinct parts of the landscape: upland, terraces and fans, rough broken land, and bottom land. It is used for range, except for small isolated areas of cropland.

Upland consists of gently sloping to moderately steep soils of the Twilight-Absher and Cabbart-Absher associations. The native vegetation is mainly mid and short grasses and some tall grasses on the more sandy soils. Upland provides feeding areas for antelope and deer. Jackrabbits, cottontails, and badgers also are common. Very few stock water ponds are present.

Terraces and fans consist of the Sorum association and the terrace parts of the Twilight-Absher and Cabbart-Absher associations. Also included are the terrace parts of those areas of the Arvada-Stetter association that are along the South Fork of Moreau River. Terraces and fans are mainly nearly level to gently sloping, and many of the soils on them have a claypan subsoil. Mid and short grasses and appreciable amounts of pricklypear cactus and low sagebrush are the vegetation on the claypan soils. Alfalfa and small grain are the main crops on the few isolated tracts of cropland. Terraces and fans provide habitat for antelope, deer, sage grouse, sharptailed grouse, jackrabbits, and cottontails.

Most of the ponds in habitat type 5 are on terraces and fans. Some are fisheries for largemouth black bass and bluegill. They also provide habitat for waterfowl and shorebirds.

Rough broken land consists of steep buttes and rough broken areas on the sides of entrenched streams and drainageways. Badland and Cabbart-Rock outcrop complex are mapping units that typify this part of the landscape. Rough broken land complements the adjacent landscapes because it provides sufficient escape habitat for antelope and deer. Bobcats and coyote are more numerous here than in other parts of the county.

Bottom land is along the North and South Forks of Moreau River and their major tributaries. Glenberg, Hanly, Haverson, Lohmiller, and Stetter soils are among the alluvial soils on bottom land. Most areas are in native vegetation and are used for range or hay. The native vegetation is mainly mid and tall grasses and stringers of broadleaf trees along the stream channels. The habitat is suitable for deer and for small fur-bearing animals, such as mink, raccoon, and skunk.

Reservoirs formed by dams constructed across the channels provide habitat for waterfowl and shorebirds. Some are suitable warm-water fisheries.

Engineering Uses of the Soils[9]

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. Some properties of the soils are of special interest to engineers because they affect construction and maintenance of roads and airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. Among these soil properties are permeability, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties is furnished in tables 5, 6, 7, and 8. The estimates and interpretations of soil properties in these tables can be used in—

1. Planning and designing drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for roads, highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreation areas.
5. Correlating performance of structures already built with properties of the soil on which they are built, in order to predict the performance of structures built on the same or similar kinds of soil in other locations.
6. Predicting the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Developing preliminary estimates for construction in a particular area.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works, particularly those that involve heavy loads or that require excavations deeper than the depths of layers here reported. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that can be expected.

Some of the terms used by soil scientists have a special meaning in soil science that may not be familiar to engineers. These and other terms are defined in the Glossary at the back of this publication.

Engineering classification

The two systems most commonly used in classifying samples of soil horizons for engineering are the AASHO (*1*) system adopted by the American Association of State Highway Officials and the Unified system (*10*) used by the Soil Conservation Service, Department of Defense, and other agencies.

The AASHO system is used to classify soils according to those properties that affect use in highway construction. In this sytem, a soil is placed in one of seven basic groups ranging from A–1 to A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are soils that have low strength if wet. The best soils for subgrade are therefore classified as A–1, the next best A–2, and so on to class A–7, the poorest soils for subgrade. If laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. If soil material is near a classification boundary, its symbol shows both classes; for example, A–2 or A–4. Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are groupd in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Some soils are on the borderline between two of these groups and are given a dual classification; for example, ML–CL.

Soil scientists use the USDA textural classification (*8*). In this, texture of the soil is determined according to the proportion of sand, silt, and clay. Textural modifiers, such as gravelly, stony, shaly, and cobbly, are used as needed.

Tables 7 and 8 show the AASHO and Unified classifications of specified soils in the county, as determined by laboratory tests. Table 5 shows the estimated classification of all soils in the county according to all these systems of classification.

Estimated engineering properties

Table 5 provides estimates of some of the soil properties important in engineering. The estimates are based on field classification and descriptions, physical and chemical tests of selected representative samples, test data from comparable soils in adjacent areas, and detailed experience in working with the individual soils in the survey area. Depth of water table is not given because the soils of the county are deep enough over the water table that it does not affect their use. Some of the terms for which data are shown are explained in the following paragraphs.

The percentage of material passing the number 4, 10, 40, and 200 sieves reflects the normal range for a specified soil. Most soils fall within the range listed in table 5, but it should not be assumed that all of them do.

Permeability, as used in table 5, relates only to

[9] HOLLIS W. ALLCOTT, agricultural engineer, Soil Conservation Service, helped prepare this section.

movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties that result from use of the soils are not considered.

Available water capacity is the ability of soils to store water available for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at wilting point of most crops. It is expressed as inches of water per inch of soil.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are defined in the Glossary.

Salinity of the soil is based on the electrical conductivity of the saturated soil extract, as expressed in millimhos per centimeter at 25° C. The salinity rating classes shown in table 5 are:

	Salinity in millimhos per centimeter
None	Less than 2
Low	2 to 4
Moderate	4 to 8
High	8 to 16
Very high	More than 16

Salinity affects the suitability of the soil for crop production, its stability if used as construction material, and its corrosivity to other materials.

Shrink-swell potential indicates the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to maintenance of structures constructed in, on, or with such material.

Corrosivity, as used here, indicates the potential danger to uncoated steel or concrete structures from chemical action that dissolves or weakens the structural material. Structural material may corrode if buried in soil. A given material corrodes more rapidly in some kinds of soil than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations entirely in one kind of soil or soil horizon.

Engineering interpretations

Table 6 contains selected information useful to engineers and others who plan to use soil material in construction of highways, farm and ranch facilities, buildings, and sewage disposal systems. Detrimental or undesirable features are emphasized, but very important desirable features also are listed. The ratings and other interpretations in this table are based on the estimated engineering properties of the soils in table 5; on available test data, including those in tables 7 and 8; and on field experience. The information strictly applies only to the soil depths indicated in table 5, but is reasonably reliable to a depth of about 6 feet for most soils.

Septic tank absorption fields are affected mainly by permeability, location of the water table, susceptibility to flooding, and slope.

Sewage lagoons are influenced mainly by permeability, location of the water table, and slope.

Shallow excavations are less than 6 feet deep and pertain to those made for such purposes as basements, ditches, graves, underground cables and pipelines, and sewers.

Ratings for dwellings are based mainly on soil characteristics that affect foundations, but slope, susceptibility to flooding, seasonal wetness, depth to bedrock, and other conditions are considered.

Sanitary landfill is a method of disposing of solid wastes on or in the soil by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with soil each day in a manner that provides maximum protection of the environment.

Local roads and streets are roadways that are expected to carry all automobile traffic but fast-moving, heavy trucks. Ratings pertain to construction and maintenance of improved roads and streets that have some kind of all-weather surfacing, such as asphalt or concrete.

Road fill is the material used as an embankment to support the subbase and base course or surface course. The ratings indicate performance of soil material moved from borrow areas for these purposes.

Sand and gravel ratings are based on the probability that the soil is a source of sand or gravel. The ratings do not indicate quality or size of the deposits.

Topsoil is soil material usable for covering barren surfaces, lawns, and gardens so as to improve soil conditions for establishing or maintaining adapted vegetation.

Pond reservoir areas are affected mainly by soil features that cause the loss of water through seepage.

Embankments, dikes, and levees are affected by features of the subsoil and substratum, such as compaction characteristics, stability after compacting, permeability, compressibility, and resistance to piping.

Drainage is influenced by those soil features that affect the installation and performance of surface and subsurface drainage facilities.

Irrigation is influenced by such soil features as water intake, available water capacity, permeability, depth of root zone, susceptibility to stream overflow, salinity, stoniness, slope, and susceptibility to water erosion and soil blowing.

Terraces and diversions are affected by soil features that affect stability or hinder layout and construction, by the probability of sedimentation in channels, and by the difficulty of establishing and maintaining cover vegetation.

Engineering test data

Table 7 lists data obtained by laboratory tests on samples from four soil profiles. The tests were performed by the South Dakota Department of Highways. These tests were conducted in accordance with standard procedures of the American Association of State Highway Officials (*1*). Some of the

TABLE 5.—*Estimates of soil*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in the first column of this table. Depth to water table is not shown because the soils in Butte County

Soil series and map symbols	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
	In	*In*					
*Absher: AbA, AbB, AeB—For Oburn part of AbA and AbB, see Oburn series. No valid estimates can be made for Slickspots part of AeB.	>40	0–5	Fine sandy loam	SM or CL	A–4		100
		5–21	Clay loam	CL	A–6 or A–7		100
		21–60	Sandy clay loam	SC or CL	A–6		100
Alice: AfB, AfC	>60	0–7	Fine sandy loam	SM or ML	A–4		100
		7–60	Fine sandy loam	SM or ML	A–4		100
Altvan: AlA, AlB	>60	0–7	Loam	ML or CL	A–4 or A–6	95–100	95–100
		7–22	Clay loam	CL	A–6	95–100	95–100
		22–60	Sand and gravel	SM, GM	A–2	50–70	30–50
Archin: AnA—Slickspots part is too variable to be rated.	>60	0–10	Fine sandy loam	SM or ML	A–4		100
		10–17	Sandy clay loam	SC or CL	A–6		100
		17–60	Fine sandy loam	SM or ML	A–4		100
Arvada: ArA, AsA—No valid estimates can be made for Slickspots part of AsA.	>60	0–2	Silt loam	ML or CL	A–4		100
		2–13	Silty clay	CL or CH	A–7		100
		13–60	Silty clay loam	CL or CH	A–7		100
Assinniboine: AtA	>60	0–6	Fine sandy loam	ML or SM	A–4		100
		6–15	Sandy clay loam	CL or SC	A–6		100
		15–22	Sandy clay loam	CL or SC	A–6		100
		22–60	Fine sandy loam	ML or SM	A–4		100
Baca: BaA, BaB	>60	0–2	Silt loam	ML or CL	A–4		100
		2–60	Silty clay loam	CL or CH	A–6 or A–7		100
Badland: Bd.—No valid estimates can be made.							
Barnum: Be, Bh	>60	0–60	Stratified silt loam, loam, and very fine sandy loam.	ML or CL	A–4		100
*Belfield: BlA, BlB—For Oburn part of BlA and BlB, see Oburn series.	>60	0–14	Silt loam	ML or CL	A–4		100
		14–19	Silty clay loam	CL or CH	A–6 or A–7		100
		19–60	Clay loam	CL or CH	A–6 or A–7		100
*Bidman: BmA, BmB, BrB—For Redig part of BrB, see Redig series.	>60	0–5	Loam	ML or CL	A–4 or A–6		100
		5–28	Clay	CH	A–7		100
		28–42	Clay loam	CL or CH	A–6 or A–7		100
		42–53	Loam	ML or CL	A–4 or A–6		100
		53–60	Gravelly loamy sand	SM	A–2 or A–4	50–80	50–80
Blackhall—Mapped only with Twilight soils.	8–20	0–8	Fine sandy loam	SM or ML	A–2 or A–4		100
		8–26	Sandstone.				
Boeek: BsB, BsC	>40	0–6	Silt loam	ML or CL	A–4 or A–6		100
		6–10	Silty clay	CL or CH	A–7		100
		10–34	Silty clay loam	CL or CH	A–6 or A–7		100
		34–44	Silt loam	ML or CL	A–4 or A–6		100
		44–54	Sandstone.				
Broadhurst: BtB	>60	0–60	Clay	CH	A–7		100
*Butche: BuD, BvF—For Boneek part of BuD, see Boneek series. No valid estimates can be made for Rock utcrop part of BvF.	6–20	0–16	Very fine sandy loam	ML or CL	A–4		100
		16–20	Siltstone.				
		20–25	Sandstone.				

properties significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for are deep enough over the water table that it does not affect their use. The symbol > means more than; the symbol < means less than]

Percentage less than 3 inches passing sieve—		Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
		In per hr	*In per in of soil*	*pH*				
70–85	40–55	2.0–6.0	0.12–0.15	6.1–7.3	None	Low	Low	Low.
90–100	70–80	<0.06	0.11–0.14	7.4–8.4	Low	High	High	Moderate.
80–90	35–55	0.6–2.0	0.13–0.15	7.4–8.4	Moderate	Moderate	High	Moderate.
70–85	40–55	2.0–6.0	0.14–0.17	6.6–7.3	None	Low	Low	Low.
70–85	40–55	2.0–6.0	0.12–0.15	6.1–7.8	None	Low	Low	Low.
70–85	50–75	1.2–2.0	0.18–0.20	6.6–7.3	None	Low	Low	Low.
85–95	70–80	0.6–1.2	0.17–0.20	6.6–7.8	None	Moderate	Moderate	Low.
15–25	5–15	6.0–10.0	0.03–0.06	7.4–8.4	None	Low	Low	Low.
70–85	40–55	2.0–6.0	0.12–0.15	5.6–7.3	None	Low	Low	Low.
80–90	35–55	<0.06	0.13–0.15	7.9–8.4	Low	Moderate	Moderate	Low.
70–85	40–55	2.0–6.0	0.09–0.12	7.9–8.4	Moderate	Low	Moderate	Moderate.
90–100	70–90	0.6–2.0	0.17–0.20	6.1–6.6	None	Low	Low	Low.
95–100	90–95	<0.06	0.08–0.13	6.6–8.4	Low	High	High	Low.
95–100	85–95	0.6–0.2	0.11–0.14	7.4–8.4	Moderate	High	High	Moderate.
70–85	40–55	2.0–6.0	0.14–0.17	6.6–7.3	None	Low	Low	Low.
80–90	35–55	0.6–1.2	0.18–0.20	6.6–7.3	None	Moderate	Moderate	Low.
80–90	35–55	0.6–1.2	0.16–0.18	6.6–7.3	None	Moderate	Moderate	Low.
70–85	40–55	2.0-6.0	0.12–0.15	6.6–7.8	None	Low	Low	Low.
90–100	70–90	0.6–2.0	0.19–0.22	6.6–7.3	None	Low	Low	Low.
95–100	85–95	0.06–0.2	0.14–0.17	6.6–8.4	Low	High	Moderate	Moderate.
85–95	50–75	0.6–2.0	0.16–0.18	6.6–8.4	None	Low	Low	Low.
90–100	70–90	0.6–2.0	0.19–0.22	6.1–7.3	None	Low	Low	Low.
95–100	85–95	0.2–0.6	0.14–0.17	6.6–7.8	None	Moderate or high	Moderate	Low.
90–100	70–80	0.2–0.6	0.14–0.17	7.8–8.4	Low	Moderate or high	Moderate	Moderate.
85–95	60–75	1.2–2.0	0.16–0.18	6.6–7.3	None	Low	Low	Low.
80–90	75–95	0.06–0.2	0.11–0.16	7.4–8.4	None	High	High	Low.
90–100	70–80	0.2–0.6	0.14–0.17	7.4–7.8	Low	Moderate	High	Moderate.
85–95	60–75	0.6–2.0	0.16–0.18	7.4–7.8	Low	Low	High	Moderate.
30–60	15–30	6.0–10.0	0.06–0.08	7.4–7.8	None	Low	High	Moderate.
70–100	30–55	2.0–6.0	0.12–0.15	7.4–8.4	None	Low	Low	Low.
95–100	85–100	0.6–2.0	0.19–0.22	6.1–6.6	None	Low or moderate	Low	Low.
95–100	90–100	0.6–1.2	0.13–0.18	6.1–6.6	None	High	Moderate	Low.
95–100	85–100	0.6–1.2	0.17–0.20	7.9–8.4	None	Moderate or high	Moderate	Low.
95–100	95–100	0.6–2.0	0.17–0.20	7.9–8.4	None	Low or moderate	Low	Low.
90–100	75–95	<0.06	0.08–0.12	4.5–5.5	Low	High	High	Moderate.
85–95	50–65	1.2–2.0	0.15–0.17	6.6–7.3	None	Low	Low	Low.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
	In	*In*					
*Cabbart: CaF, CbD, CcF, CgD For Lismas part of CbD, see Lismas series. For Scroggin part of CgD, see Scroggin series. No valid estimates can be made for Rock outcrop part of CcF.	8–20	0–13	Loam	ML or CL	A–4 or A–6		100
		13–20	Siltstone and sandstone.				
*Canyon: ClF For Colby part, see Colby series.	8–20	0–14	Very fine sandy loam	ML or CL	A–4		100
		14–24	Sandstone.				
Caputa: CmA, CmB, CmC	>60	0–9	Loam	ML or CL	A–4 or A–6		100
		9–60	Clay loam	CL or CH	A–6 or A–7		100
Chinook: CnA	>60	0–5	Fine sandy loam	SM or ML	A–4		100
		5–18	Fine sandy loam	SM or ML	A–4		100
		18–60	Stratified loam, fine sandy loam, and sandy loam.	ML or SM	A–4		100
*Colby: CoD For Canyon part, see Canyon series.	>40	0–42	Silt loam	ML or CL	A–4 or A–6		100
		42–60	Loamy very fine sand	SM or ML	A–4		100
Demar Mapped only with Slickspots.	36–50	0–5	Loam	ML or CL	A–4 or A–6		100
		5–41	Silty clay	CH	A–7		100
		41–50	Shale.				
Dix: DsA	>60	0–7	Fine sandy loam	SM, SC, or ML	A–4 or A–2		100
		7–14	Fine sandy loam	SM, SC, or ML	A–4 or A–2		100
		14–17	Gravelly clay loam	CL	A–6	70–95	70–95
		17–40	Gravel and sand	GW or GM	A–1 or A–2	20–50	15–30
Epsie: EpD, EsE No valid estimates can be made for Shale land part of EsE.	6–20	0–14	Clay	CH	A–7		100
		14–30	Shale	CH	A–7		100
*Glenberg: GgA, GgB, Gh For Haverson part of Gh, see Haverson series.	>60	0–35	Fine sandy loam	SM or ML	A–4		100
		35–60	Loamy sand	SM	A–2		100
Graner: GnC	>60	0–60	Clay	CH	A–7		100
Grummit: GrE	5–20	0–17	Clay	CH	A–7		100
		17–40	Shale	CH	A–7		100
Hanly: Ha	>60	0–34	Loamy fine sand	SM	A–2		100
		34–60	Loamy sand	SM	A–2		100
Haverson: HeA, HeB	>60	0–60	Stratified loam, silt loam, and very fine sandy loam.	ML or CL	A–4 or A–6		100
Hisle: HlB, HsB No valid estimates can be made for Slickspots part of HsB.	20–40	0–2	Loam	ML or CL	A–4 or A–6		100
		2–35	Clay	CH	A–7		100
		35–50	Shale	CH	A–7		100
Keith: KeA, KeB, KeC	>60	0–13	Silt loam	ML or CL	A–4 or A–6		100
		13–60	Silt loam	ML or CL	A–4 or A–6		100
*Kyle: KlA, KlB, KlC, Kt, KuB For Pierre part of KuB, see Pierre series.	>40	0–60	Clay	CH	A–7		100

significant in engineering—Continued

Percentage less than 3 inches passing sieve—		Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
		In per hr	*In per in of soil*	*pH*				
85–95	50–90	0.6–2.0	0.16–0.18	7.4–8.4	None	Low	High	Low.
85–95	50–65	1.2–2.0	0.15–0.17	7.4–8.4	None	Low	Low	Low.
85–95	60–75	1.2–2.0	0.18–0.20	6.1–7.3	None	Low	Low	Low.
90–100	70–80	0.2–0.6	0.14–0.17	7.4–8.4	None	High	Moderate	Low.
70–85	40–55	2.0–6.0	0.14–0.17	6.6–7.3	None	Low	Low	Low.
70–85	40–55	2.0–6.0	0.12 0.15	6.6–7.8	None	Low	Low	Low.
60–85	30–75	2.0–6.0	0.12–0.15	7.4–8.4	None	Low	High	Low.
90–100	70–90	0.6–2.0	0.17–0.20	6.6–7.8	None	Low	Low	Low.
90–95	40–60	6.0–10.0	0.08–0.10	7.4–7.8	None	Low	Low	Low.
85–95	60–75	1.2–2.0	0.16–0.18	6.6–7.3	None	Low	Low	Low.
90–100	75–95	<0.06	0.08–0.12	3.8–5.5	High	High	High	High.
60–85	30–55	2.0–6.0	0.14–0.17	6.6–7.3	None	Low	Low	Low.
60–85	30–55	2.0–6.0	0.12–0.15	7.4–7.8	None	Low	Low	Low.
60–85	55–65	2.0–6.0	0.17–0.20	7.4–7.8	None	Moderate	Low	Low.
15–30	0–15	6.0–10.0	0.03–0.06	7.4–7.8	None	Low	Low	Low.
90–100	75–95	<0.06	0.08–0.12	6.6–7.8	Very high	High	High	High.
95–100	95–100	<0.02		7.9–8.4	Very high	High	High	High.
70–85	40–55	2.0–6.0	0.12–0.15	6.6–7.8	None	Low	Low	Low.
50–75	15–30	6.0–10.0	0.08–0.10	7.4–8.4	None	Low	Low	Low.
90–100	75–95	0.6–2.0	0.08–0.12	3.5–5.0	None	High	High	High.
90–100	75–95	0.6–2.0	0.08 0.12	3.5 5.0	None	High	Moderate	High.
95–100	85–100	<0.02		<4.5	None	High	High	High.
65–80	20–35	6.0–10.0	0.08–0.10	7.4–7.8	None	Low	Low	Low.
50–75	15–30	6.0–10.0	0.08–0.10	7.4–7.8	None	Low	Low	Low.
85–95	50–80	0.6–2.0	0.16–0.18	7.4–7.8	None	Low	Low	Low.
85–95	60–75	1.2–2.0	0.16–0.18	6.1–7.3	None	Low	Low	Low.
90–100	75–95	<0.06	0.05–0.09	7.4–8.4	Low	Moderate	High	Moderate.
90–100	90–100	<0.02		7.4–8.4	Low	High	High	Moderate.
90–100	70–90	0.6–2.0	0.19–0.22	6.6–7.3	None	Low or moderate	Moderate	Low.
90–100	70–90	0.6–2.0	0.17–0.20	7.4–7.8	None	Low or moderate	Moderate	Low.
90–100	75–95	<0.06	0.08–0.12	7.4–8.4	Low	High	High	Moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
	In	*In*					
*Lakoa: LaF	20–40	0–2	Silt loam	ML or CL	A–4 or A–6		100
For Colby part, see Colby series.		2–16	Clay loam	CL	A–6 or A–7		100
		16–20	Sandy clay	CL or SC	A–6		100
		20–31	Sandy loam	SM	A–2 or A–4		100
		31–40	Sandstone.				
*Lismas: LcE, LeD	6–20	0–16	Clay	CH	A–7		100
For Pierre part of LeD, see Pierre series.		16–30	Shale	CH	A–7		100
Loamy alluvial land: Lm. No valid estimates can be made.							
Lohmiller:							
LnA, LnB	>60	0–60	Silty clay loam	CL or CH	A–6 or A–7		100
Lo	>60	0–60	Silty clay loam	CL or CH	A–6 or A–7		100
Lohmiller variant: Ls	>60	0–60	Silty clay loam	CL or CH	A–6 or A–7		100
Manter: MaA, MaB	>60	0–16	Fine sandy loam	SM or ML	A–4		100
		16–60	Fine sandy loam	SM or ML	A–4		100
Manvel: McA, McB	>40	0–60	Silty clay loam	ML or CL	A–6		100
Marsh: Mh. No valid estimates can be made.							
Mawer: MlA, MlB	>60	0–8	Fine sandy loam	SM or ML	A–4		100
		8–22	Fine sandy loam	SM or ML	A–4		100
		22–60	Gravelly loamy fine sand	GP or GM	A–1, A–2	30–70	10–65
McKenzie: Mn	>60	0–60	Clay	CH	A–7		100
*Midway: MoE, MrD	6–20	0–13	Silty clay loam	CL or CH	A–6 or A–7		100
For Razor part of MrD, see Razor series.		13–40	Shale.				
*Minatare: Ms	>60	0–2	Fine sandy loam	SM or ML	A–4		100
For Whitelake part, see Whitelake series.		2–6	Clay loam	CL	A–6 or A–7		100
		6–21	Fine sandy loam	SM or ML	A–4		100
		21–40	Sandy clay loam	SC or CL	A–6		100
		40–60	Gravelly loamy sand	GM or GP	A–1 or A–2	20–40	15–25
Mine pits and dumps: Mt. No valid estimates can be made.							
Minnequa: MuB, MuC	20–40	0–24	Silty clay loam	ML or CL	A–6		100
		24–50	Shale.				
*Nevee: NeB, NsD	>40	0–48	Silt loam	ML	A–4		100
For Spearfish part of NsD, see Spearfish series.		48–60	Siltstone.				
Oburn: ObA	>60	0–10	Fine sandy loam	ML or SM	A–4		100
		10–23	Clay loam	CL	A–6		100
		23–60	Sandy clay loam	CL	A–6		100
Parshall: PaA	>60	0–31	Fine sandy loam	SM or ML	A–4		100
		31–60	Fine sandy loam	SM or ML	A–4		100
*Penrose: PeE, PmD	8–20	0–13	Silty clay loam	ML or CL	A–6		100
For Minnequa part of PmD, see Minnequa series.		13–30	Shale.				
Pierre: PrA, PrB, PrD	20–40	0–28	Clay	CH	A–7		100
		28–55	Shale	CH	A–7		100

significant in engineering—Continued

Percentage less than 3 inches passing sieve—		Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
		In per hr	*In per in of soil*	*pH*				
85–95	70–90	0.6–2.0	0.17–0.20	5.6–6.5	None	Low	Low	Moderate.
90–100	70–80	0.6–1.2	0.14–0.17	5.6–6.0	None	Moderate	Moderate	Moderate.
80–90	35–55	0.6–1.2	0.14–0.17	5.6–6.0	None	Moderate	Moderate	Moderate.
60–70	30–40	2.0–6.0	0.09–0.13	5.6–6.0	None	Low	Low	Moderate.
90–100	75–95	<0.06	0.08–0.12	6.6–7.8	Low	High	High	Moderate.
95–100	90–100	<0.02		5.6–7.8	Low	High	High	Moderate.
95–100	85–95	0.06–0.2	0.14–0.17	6.6–7.8	None	High	High	Low.
95–100	85–95	0.06–0.2	0.11–0.14	6.6–7.3	High	High	High	High.
95–100	85–95	0.06–0.2	0.14–0.17	4.5–6.0	None	High	Moderate	High.
70–85	40–55	2.0–6.0	0.14 0.17	6.6–7.3	None	Low	Moderate	Low.
70–85	40–55	2.0–6.0	0.12–0.15	6.6–7.8	None	Low	Moderate	Low.
95–100	85–95	0.2–0.6	0.14–0.17	7.4–8.4	Low	Moderate	Moderate	Low.
70–85	40–55	2.0–6.0	0.14–0.17	6.1–7.3	None	Low	Low	Low.
70–85	40–55	2.0–6.0	0.12–0.15	6.6–7.3	None	Low	Low	Low.
10–65	2–30	6.0–10.0	0.03–0.06	7.4–7.8	None	Low	Low	Low.
90–100	75–95	<0.06	0.08–0.12	6.6–7.3	Low	High	High	Moderate.
95–100	85–95	0.06–0.2	0.14–0.17	7.4–8.4	None	High	High	Low.
70–85	40–55	2.0–6.0	0.12–0.15	7.4–8.4	Moderate	Low	Low	Low.
90–100	70–80	<0.06	0.11–0.14	7.9–8.4	High	Moderate or high	High	Low.
70–85	40–55	2.0–6.0	0.09–0.12	7.9–8.4	High	Low	High	High.
80–90	35–55	0.2–0.6	0.13–0.15	7.9–8.4	High	Moderate	High	High.
15–25	5–15	6.0–10.0	0.03–0.06	7.9–8.4	High	Low	High	High.
95–100	85–95	0.2–0.6	0.14–0.17	7.4–8.4	Low	Moderate	High	Low.
90–100	85–100	0.6–2.0	0.17–0.20	6.6–7.8	None	Low	High	Moderate.
75–85	40–55	2.0–6.0	0.12–0.15	6.6–7.8	None	Low	Low	Low.
90–100	70–80	<0.06	0.11–0.14	6.6–8.4	Low	High	High	Moderate.
70–85	40–55	<0.06	0.13–0.15	7.9–8.4	Moderate	Moderate	High	Moderate.
70–85	40–55	1.2–6.0	0.14–0.17	6.1–7.3	None	Low	Moderate	Low.
70–85	40–55	1.2–6.0	0.12–0.15	6.6–7.3	None	Low	Moderate	Low.
95–100	85–95	0.2–0.6	0.14–0.17	7.4–8.4	None	Moderate	High	Low.
90–100	75–95	<0.06	0.08–0.12	6.6–8.4	Low	High	High	Moderate.
95–100	90–100	<0.02		6.1–7.8	Low	High	High	Moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
	In	*In*					
Ralph: RaB	20–40	0–6	Loam	ML or CL	A–4 or A–6		100
		6–34	Clay loam	CL or ML–CL	A–6		100
		34–51	Shale.				
		51–60	Sandstone.				
Razor: RcA, RcB, RcC	20–40	0–2	Silt loam	ML or CL	A–4		100
		2–30	Silty clay loam	CL or CH	A–6 or A–7		100
		30–48	Shale.				
Redig: RdE	>60	0–3	Clay loam	ML or CL	A–4 or A–6	85–95	85–95
		3–18	Loam	ML or CL	A–4 or A–6	85–90	85–90
		18–45	Gravelly loam	SC or CL	A–4 or A–6	65–85	65–85
		45–60	Gravelly clay loam	SC or CL	A–4 or A–6	50–70	50–70
Riverwash: Rh. No valid estimates can be made.							
*Rock outcrop: RsF. No valid estimates can be made for Rock outcrop part. For Spearfish part, see Spearfish series.							
Saline-Alkali land: Sa. No valid estimates can be made.							
Saline alluvial land: Sb. No valid estimates can be made.							
Satanta: ScA, ScB, ScC	>60	0–8	Loam	ML or CL	A–4 or A–6		100
		8–23	Clay loam	CL	A–6		100
		23–31	Sandy clay loam	SC or CL	A–6		100
		31–60	Loam	ML or CL	A–4 or A–6		100
Savo: SdA, SdB	>60	0–7	Silty clay loam	CL	A–6		100
		7–60	Silty clay loam	CL or CH	A–6 or A–7		100
Schamber: SeE	>60	0–2	Loam	ML or CL	A–4 or A–6	95–100	95–100
		2–10	Gravelly loam	ML or CL	A–4	80–85	80–85
		10–60	Gravel	GM or GP	A–1	30–50	30–50
Scroggin	20–40	0–23	Loam	ML or CL	A–4 or A–6		100
Mapped only with Cabbart soils.		23–27	Siltstone.				
*Shale land: Sg, ShF. No valid estimates can be made for Shale land. For Grummit part of ShF, see Grummit series.							
*Slickspots: SkB, SlB. No valid estimates can be made for Slickspots part of SkB and SlB. For Demar part of SkB, see Demar series. For Wasa part of SlB, see Wasa series.							
Snomo: SmE		0–52	Clay	CH	A–7		100
No valid estimates can be made for Shale land part.		52–60	Shale.				
Sorum: SnB	>60	0–15	Fine sandy loam	SM or ML	A–4		100
		15–33	Clay loam	CL	A–6		100
		33–60	Sandy loam	SM or SC	A–2 or A–4		100

significant in engineering—Continued

Percentage less than 3 inches passing sieve—		Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
		In per hr	*In per in of soil*	*pH*				
85–95	60–75	1.2–2.0	0.18–0.20	6.6–7.3	None	Low	Low	Low.
90–100	70–80	0.6–1.2	0.17–0.20	6.6–7.8	None	Moderate	Moderate	Low.
90–100	70–90	0.6–2.0	0.17–0.20	6.6–7.3	None	Low	Low	Low.
95–100	85–95	0.06–0.2	0.14–0.17	6.6–8.4	Low	High	Moderate	Moderate.
75–85	60–75	0.6–1.2	0.17–0.20	6.6–7.3	None	Moderate	Low	Low.
75–85	60–70	0.6–1.2	0.16–0.18	7.4–7.8	Low	Low or moderate	Moderate	Moderate.
60–75	45–60	0.6–1.2	0.08–0.10	7.4–7.8	Low	Low or moderate	Moderate	High.
50–60	30–55	2.0–6.0	0.03–0.06	7.4–7.8	Low	Low or moderate	Moderate	High.
85–95	60–75	1.2–2.0	0.18–0.20	6.1–6.6	None	Low	Low	Low.
90–100	70–80	0.6–1.2	0.17–0.20	6.1–6.6	None	Moderate	Moderate	Low.
80–90	35–55	0.6–1.2	0.17–0.20	7.4–7.8	None	Moderate	Moderate	Low.
85–95	60–75	1.2–2.0	0.16–0.18	7.4–7.8	None	Low	Moderate	Low.
95–100	85–95	0.6–1.2	0.19–0.22	6.6–7.3	None	Moderate	Low	Low.
95–100	85–95	0.2–0.6	0.14–0.17	6.6–7.8	Low	Moderate or high	High	Moderate.
80–90	55–70	1.2–2.0	0.18–0.20	7.4–7.8	None	Low	Low	Low.
65–75	50–60	2.0–6.0	0.16–0.18	7.4–7.8	None	Low	Moderate	Low.
15–35	0–15	6.0–10.0	0.03–0.06	7.4–7.8	None	Low	Moderate	Low.
85–95	60–75	1.2–2.0	0.16–0.18	6.6–8.4	Low	Low	Low	Low.
90–100	75–95	0.6–1.2	0.08–0.12	4.0–5.1	None	High	High	High.
70–85	40–55	2.0–6.0	0.14–0.17	6.0–7.8	None	Low	Low	Low.
90–100	70–80	<0.06	0.14–0.17	7.9–8.4	Low	Moderate	High	Moderate.
60–70	30–40	2.0–6.0	0.09–0.13	7.9–8.4	Moderate	Low	High	Moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
	In	*In*					
Spearfish	<20	0–15	Silt loam	ML or CL	A–4		100
Mapped only with Nevee series and Rock outcrop.		15–30	Sandstone.				
Stetter: Sr, Ss	>60	0–60	Clay	CH	A–7		100
Stony steep land: St. No valid estimates can be made.							
Swanboy: SuA, Sv	>60	0–60	Clay	CH	A–7		100
No valid estimates can be made for Slickspots part of Sv.							
Terrace escarpments: Te. No valid estimates can be made.							
*Twilight: TfD, TgC, ThD	20–40	0–28	Fine sandy loam	SM or ML	A–4		100
For Assinniboine part of TgC, see Assinniboine series. For Blackhall part of ThD, see Blackhall series.		28–60	Sandstone.				
Twotop: ToB	>60	0–60	Clay	CH	A–7		100
Vale: VaA	>60	0–9	Silt loam	ML or CL	A–4 or A–6		100
		9–28	Silty clay loam	CL	A–6		100
		28–60	Very fine sandy loam	ML or CL	A–4		100
Wasa: WaB	20–40	0–22	Clay	CH	A–7		100
No valid estimates can be made for Slickspots part.		22–50	Shale	CH or MH	A–7		
Whitelake: WhA	>60	0–8	Fine sandy loam	SM or ML	A–4		100
		8–11	Fine sandy loam	SM or SC	A–4		100
		11–40	Sandy loam	SM or SC	A–2 or A–4		100
		40–60	Gravel and sand	SM or SP	A–2	30–50	20–40
Winler: WnB	20–40	0–31	Clay	CH	A–7		100
		31–45	Shale.				
Zeona: ZeB	>60	0–60	Fine sand	SM	A–2		100

significant in engineering—Continued

Percentage less than 3 inches passing sieve—		Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
		In per hr	*In per in of soil*	*pH*				
90–100	70–90	0.6–2 0	0.17–0.20	7.9–8.4	Low	Low	High	Moderate.
90–100	75–95	0.06–0.2	0.08–0.12	6.6–7.8	Low	High	High	Moderate.
90–100	75–95	<0.06	0.05–0.09	6.6–8.4	Moderate	High	High	High.
70–85	40–55	2.0–6.0	0.12–0.15	6.6–8.4	None	Low	Moderate	Low.
90–100	95–100	<0.06	0.08–0.12	6.6–7.8	Low	High	High	Moderate.
90–100	75–95	0.6–2.0	0.19–0.22	6.6–7.3	None	Low	Low	Low.
95–100	85–95	0.6–1.2	0.17–0.20	6 6–7.8	None	Moderate	Moderate	Low.
85–95	50–65	1.2–2.0	0.15–0.17	7.4–8.4	None	Low	Moderate	Low.
90–100	95–100	<0.06	0.05–0.09	6.6–7.8	Moderate	High	High	High.
100	95–100	<0.02		6.6–7.3	Moderate	High	High	High.
70–85	40–55	2.0–6.0	0.14–0.17	6.6–7.3	None	Low	Low	Low.
70–85	35–50	0.06–0.2	0.09–0.12	7.4–8.4	Low	Low	High	Low.
60–70	30–40	2.0–6.0	0.06–0.10	7.9–9.0	High	Low	High	Moderate.
15–25	5–15	6.0–10.0	0.03–0.06	7.9–9.0	High	Low	High	Moderate.
95–100	95–100	<0.06	0.08–0.12	6.6–7.8	Slight	High	High	Moderate.
50–80	15–35	6.0–10.0	0.06–0.08	6.6–7 3	None	Low	Low	Low.

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such ring to other series that appear

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Shallow lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
*Absher: AbA, AbB, AeB. For Oburn part of AbA and AbB, see Oburn series. Slickspots part of AeB is too variable to be rated.	Severe: very slow permeability.	Slight if slope is less than 2 percent; moderate if slope is more than 2 percent.	Severe: dense, compact subsoil.	Severe: high shrink-swell potential; dense, compact subsoil.	Moderate: clay loam texture; poor cover material.	Severe: AASHO Group Index more than 8; high shrink-swell potential.
Alice: AfB, AfC	Slight [3]	Severe: moderately rapid permeability.	Slight	Slight or moderate: fair to poor stability.	Severe: moderately rapid permeability.	Slight or moderate: SM or ML material.
Altvan: AlA, AlB	Slight [3]	Severe: rapid permeability in substratum.	Severe: very gravelly substratum.	Moderate: moderate shrink-swell potential.	Severe: rapid permeability in substratum.	Moderate: moderate shrink-swell potential.
Archin: AnA. Slickspots part is too variable to be rated.	Slight [3]	Severe: moderately rapid permeability in substratum.	Moderate: dense, compact subsoil.	Moderate: moderate shrink-swell potential; dense, compact subsoil.	Severe: moderately rapid permeability in substratum.	Moderate: moderate shrink-swell potential.
Arvada: ArA, AsA. Slickspots part of AsA too variable to be rated.	Severe: very slow permeability.	Slight	Severe: dense, compact subsoil.	Severe: high shrink-swell potential; dense, compact subsoil.	Severe: silty clay texture.	Severe: high shrink-swell potential.
Assinniboine: AtA	Slight [3]	Severe: moderately rapid permeability in substratum.	Slight	Moderate: moderate shrink-swell potential.	Severe: moderately rapid permeability in substratum.	Moderate: moderate shrink-swell potential.
Baca: BaA, BaB	Severe: slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent.	Slight	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; silty clay loam texture.	Severe: high shrink-swell potential.

See footnotes at end of table.

interpretations

mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for refer- in the first column of this table]

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: AASHO Group Index more than 8.	Unsuited [2]_____	Poor: surface layer 5 inches thick; dense, compact subsoil.	Possible seepage in substratum.	Fair or good stability and compaction characteristics.	Very slow permeability; dense, compact subsoil.	Dense, compact subsoil; very slow permeability.	Dense, compact subsoil; very slow permeability.
Good or fair: fair or poor stability.	Poor or unsuited: fines.	Good_____	Moderately rapid permeability.	Poor resistance to piping.	Moderately rapid permeability.	Moderately rapid water intake rate; moderate available water capacity.	Moderately rapid permeability in substratum.
Fair: moderate shrink-swell potential.	Poor: fines___	Good to a depth of 7 inches; fair below; firm consistence.	Sand and gravel substratum; high seepage.	High seepage potential; poor to good stability; poor or fair resistance to piping.	Rapid permeability in substratum.	Low or moderate available water capacity; rapid permeability in substratum; moderate water intake rate.	Sand and gravel substratum; low to moderate available water capacity.
Fair: moderate shrink-swell potential.	Unsuited [2]_____	Poor: subject to soil blowing; dense, compact subsoil.	Moderately rapid permeability in substratum.	Poor resistance to piping; moderate permeability if compacted.	Very slow permeability; dense, compact subsoil.	Dense, compact subsoil; very slow permeability; possible salt accumulation.	Dense, compact subsoil; very slow permeability.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: surface layer 2 inches thick; dense, compact subsoil.	Very slow permeability; low seepage.	Fair or poor stability and compaction characteristics; high compressibility; high volume change.	Very slow permeability; dense, compact subsoil.	Dense, compact subsoil; very slow permeability; possible salt accumulation.	Dense, compact subsoil; very slow permeability.
Fair: moderate shrink-swell potential.	Poor: fines, no gravel.	Good_____	Moderately rapid permeability in substratum; high seepage.	Poor resistance to piping; moderate permeability when compacted.	Moderate permeability.	Moderate water intake rate; moderate available water capacity; deep root zone.	Moderately rapid permeability in substratum.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: firm consistence; limy below a depth of 8 inches.	Slow permeability; low seepage potential.	High volume change; medium or high compressibility; fair or poor stability.	Slow permeability.	Slow water intake rate; moderate available water capacity.	Slow permeability; long smooth slope.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Badland: Bd. No interpretations; material too variable to be rated.						
Barnum: Be, Bh	Moderate: moderate permeability. Severe in areas subject to flooding.	Moderate: moderate permeability. Severe in areas subject to flooding.	Slight or severe: some areas subject to flooding.	Moderate or severe: ML or CL material; some areas subject to flooding.	Slight or severe: some areas subject to flooding.	Moderate or severe: ML or CL material; some areas subject to flooding.
*Belfield: BlA, BlB. For Oburn part of BlA and BlB, see Oburn series.	Severe: moderately slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent.	Moderate: clay loam texture.	Moderate or severe: moderate or high shrink-swell potential.	Moderate: silty clay loam and clay loam textures.	Severe: AASHO Group Index more than 8.
*Bidman: BmA, BmB, BrB. For Redig part of BrB, see Redig series.	Severe: slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent; severe if slope is more than 6 percent.	Moderate: dominantly clay loam and loam texture.	Moderate: moderate shrink-swell potential below 28 inches.	Severe: clay texture; possible seepage in substratum.	Severe: high shrink-swell potential.
Blackhall. Mapped only with Twilight series.	Moderate if slope is less than 15 percent; severe if more than 15 percent.	Severe: less than 20 inches deep over sandstone; slope more than 6 percent.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Severe: moderately rapid permeability; high seepage.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.
Boneek: BsB, BsC	Moderate: moderate permeability.	Moderate if slope is less than 6 percent; severe if slope is more than 6 percent: moderate permeability.	Moderate or severe: bedrock at a depth of 40 to 60 inches; bedrock difficult to excavate.	Moderate or severe: moderate or high shrink-swell potential.	Severe: silty clay loam texture; bedrock at a depth of 40 to 60 inches; difficult to excavate.	Severe: AASHO Group Index more than 8.
Broadhurst: BtB	Severe: very slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Fair: fair or poor stability.	Unsuited [2]	Fair: limy	Most slopes on bottom land and low terraces less than 2 percent.	Good or poor stability and compaction characteristics.	Moderate permeability; some areas subject to flooding.	Moderate water intake rate; high available water capacity; deep root zone.	Bottom land and low terraces nearly level.
Poor: AASHO Group Index more than 8.	Unsuited [2]	Good to a depth of 14 inches; fair below.	Moderately slow permeability; low seepage potential.	Moderate or high shrink-swell potential; medium or high compressibility.	Moderately slow permeability.	Slow water intake rate; high available water capacity; deep root zone.	Moderately slow permeability.
Poor: high shrink-swell potential.	Unsuited: [2] possible source of varying thickness below depth of 60 inches.	Good to a depth of 5 inches, poor below; very firm.	High seepage in gravelly substratum.	High volume change; medium or high compressibility.	Slow permeability.	Slow water intake rate; moderate or high available water capacity; deep root zone.	Slow permeability in subsoil; sand and gravel substratum.
Poor: less than 20 inches deep over sandstone.	Poor: fines; soft sandstone bedrock; no gravel.	Poor: less than 20 inches deep over sandstone; subject to soil blowing.	High seepage potential; less than 20 inches deep over soft sandstone.	Poor resistance to piping; moderate permeability when compacted; limited material.	Less than 20 inches deep over bedrock.	Shallow over sandstone; sloping to moderately steep areas.	Shallow over sandstone; sloping to moderately steep, short slopes.
Poor: AASHO Group Index more than 8.	Unsuited [2]	Good to a depth of 7 inches, fair below; silty clay loam texture.	Moderate permeability; possible seepage in bedrock fractures.	Moderate or high shrink-swell potential; medium or high compressibility.	Moderate permeability.	Moderately slow water intake rate; high available water capacity; deep root zone.	Moderate permeability; most slopes between 2 and 9 percent; long, smooth slopes.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: clay texture.	Very slow permeability; low seepage.	Fair to poor stability; high compressibility.	Very slow permeability; dense, clayey subsoil.	Dense, clayey subsoil; very slow permeability.	Very slow permeability; dense, clayey subsoil.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
*Butche: BuD, BvF. For Boneek part of BuD, see Boneek series. Rock outcrop part of BvF too variable to be rated.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over hard bedrock.	Severe: less than 20 inches deep over hard bedrock.	Severe: less than 20 inches deep over hard bedrock.	Severe: most slopes more than 15 percent.
*Cabbart: CaF, CbD, CcF, CgD. For Lismas part of CbD, see Lismas series. For Scroggin part of CgD, see Scroggin series. Rock outcrop part of CcF too variable to be rated.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Moderate if slopes is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 25 percent; severe if slope is more than 25 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: ML or CL material.
*Canyon: CIF. For Colby part, see Colby series.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 25 percent; severe if slope is more than 25 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: ML or CL material.
Caputa: CmA, CmB, CmC	Severe: moderately slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent; severe if slope is more than 6 percent.	Moderate: clay loam texture.	Severe: high shrink-swell potential.	Moderate: clay loam texture.	Severe: high shrink-swell potential.
Chinook: CnA	Slight [3]	Severe: moderately rapid permeability.	Slight	Slight or moderate: SM or ML material.	Severe: moderately rapid permeability.	Slight or moderate: SM or ML material.
*Colby: CoD. For Canyon part, see Canyon series.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: bedrock generally within a depth of 72 inches.	Severe: rapid permeability in substratum.	Slight if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: ML or CL material.	Severe: rapid permeability in substratum.	Slight or moderate if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent: ML or CL material.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: less than 20 inches deep over hard bedrock.	Unsuited [2]	Poor: stony; less than 20 inches deep over bedrock; steep slopes.	Fractured rock; high seepage potential; steep.	Shallow over bedrock; many stones and cobblestones.	Strongly sloping to steep.	Shallow over bedrock; strongly sloping to steep.	Shallow over bedrock; strongly sloping to steep.
Poor: 20 to 40 inches deep over bedrock.	Unsuited [2]	Poor: less than 20 inches deep over bedrock; limy surface layer.	Less than 20 inches deep over bedrock; possible seepage in fractures.	Fair or poor stability and compaction characteristics; limited material.	Strongly sloping to steep.	Strongly sloping to steep; shallow over bedrock.	Strongly sloping to steep; shallow over bedrock.
Poor: less than 20 inches deep over bedrock.	Unsuited [2]	Poor: less than 20 inches deep over bedrock; limy surface layer.	Less than 20 inches deep over bedrock; possible seepage in fractures.	Fair or poor stability and compaction characteristics; limited material.	Strongly sloping to steep.	Strongly sloping to steep; shallow over bedrock.	Strongly sloping to steep; shallow over bedrock.
Poor: high shrink-swell potential.	Unsuited: [2] possible source of varying thickness below a depth of 60 inches.	Good to a depth of 9 inches; fair below.	Moderately slow permeability; low seepage.	High shrink-swell potential; fair or poor stability and compaction characteristics; medium or high compressibility.	Moderately slow permeability; nearly level to sloping.	Moderately slow permeability; moderate or high available water capacity; slow water intake rate.	Nearly level to sloping; clay loam texture; moderately slow permeability.
Good or fair: SM or ML material.	Poor: fines; no gravel.	Good	Moderately rapid permeability; high seepage.	Low or moderate permeability when compacted; poor resistance to piping.	Moderately rapid permeability; nearly level.	Moderately rapid permeability; moderate or high available water capacity; moderate water intake rate.	Nearly level; moderately rapid permeability.
Fair: ML or CL material.	Poor: fines	Fair or poor: limy; steep slopes.	Rapid permeability in substratum; high seepage potential.	Poor resistance to piping; fair or poor stability and compaction characteristics.	Sloping to moderately steep.	Moderate permeability; moderate or high available water capacity; sloping to moderately steep.	Sloping to moderately steep, irregular slopes.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Demar Mapped only with Slickspots.	Severe: very slow permeability.	Moderate: 36 to 50 inches deep over shale.	Severe: silty clay texture; dense, compact subsoil.	Severe: high shrink-swell potential; dense, compact subsoil.	Severe: silty clay texture.	Severe: high shrink-swell potential.
Dix: DsA	Slight [2]	Severe: rapid permeability.	Severe: very gravelly substratum.	Slight	Severe: rapid premeability.	Slight
Epsie: EpD, EsE Shale land part of EsE too variable to be rated.	Severe: very slow permeability; less than 20 inches deep over shale.	Severe: less than 20 inches deep over shale.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
*Glenberg: GgA, GgB, Gh For Haverson part of Gh, see Haverson series.	Slight or severe: some areas subject to flooding.	Moderate: moderate to rapid permeability.	Severe: loamy sand texture in lower part of substratum.	Slight to severe: SM or ML material; some areas subject to flooding.	Moderate: moderate or rapid permeability.	Slight to severe: SM or ML material; some areas subject to flooding.
Graner: GnC	Moderate: gently sloping to moderately steep.	Severe: moderately rapid permeability.	Moderate: friable clay texture.	Severe: high shrink-swell potential.	Severe: moderately rapid permeability.	Severe: high shrink-swell potential.
Grummit: GrE	Severe: less than 20 inches deep over shale.	Severe: less than 20 inches deep over shale.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Hanly: Ha	Severe: subject to flooding.	Severe: rapid permeability; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; rapid permeability.	Severe: subject to flooding.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited [2]	Poor: 5 inches thick; dense, compact subsoil.	Shale below depth of 36 inches; possible seepage in fractures.	Fair or poor stability and compaction characteristics; high compressibility.	Dense, compact subsoil; nearly level to gently sloping.	Dense, compact subsoil; possible salt accumulation.	Dense, compact subsoil.
Good	Good to poor: fines.	Poor: less than 20 inches deep over sand and gravel; difficult to revegetate.	Rapid permeability; high seepage potential.	Moderate or high permeability when compacted; fair or good resistance to piping.	Rapid permeability in substratum; neary level.	Shallow over sand and gravel; low available water capacity; rapid water intake rate.	Shallow over sand and gravel.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: clay texture.	Less than 20 inches deep over shale; possible seepage in fractures.	High shrink-swell potential; fair or poor stability and compaction characteristics; high compressibility.	Strongly sloping to steep; salt accumulation; very slow permeability.	Shallow over shale; salt accumulation.	Shallow over shale; strongly sloping to steep.
Good or fair: SM or ML material.	Poor: fines	Good	Moderate permeability.	Moderate permeability when compacted; poor resistance to piping.	Moderate permeability; some areas subject to stream overflow.	Moderate available water capacity; moderately rapid water intake rate; some areas subject to flooding.	Nearly level bottom land and low terraces.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: clay texture; subject to soil blowing.	Moderately rapid permeability; high seepage.	Fair or poor stability and compaction characteristics; high compressibility.	Moderately rapid permeability; subject to soil blowing.	Subject to soil blowing; gently to moderately steep.	Subject to soil blowing; moderate permeability.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: clay texture.	Less than 20 inches deep over shale; possible seepage in fractures.	Limited material; fair or poor stability and compaction characteristics; high compressibility.	Sloping to steep; shallow over shale.	Shallow over shale; sloping to steep.	Shallow over shale; sloping to steep.
Good	Poor: fines	Poor: loamy fine sand texture; subject to soil blowing.	Rapid permeability; high seepage.	Poor resistance to piping; moderate permeability when compacted.	Subject to flooding; rapid permeability.	Subject to flooding; very rapid water intake rate.	Nearly level bottom land; subject to flooding.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Haverson: HeA, HeB	Moderate: moderate permeability. Severe in areas subject to flooding.	Moderate or severe: moderate permeability; subject to flooding in some areas.	Slight: severe in areas subject to flooding.	Moderate or severe: ML or CL material; subject to flooding in some areas.	Slight or severe: subject to flooding in some areas.	Moderate or severe: ML or CL material; subject to flooding in some areas.
Hisle: HlB, HsB Slickspots part of HsB too variable to be rated.	Severe: very slow permeability.	Slight if slope is less than 2 percent, moderate if 2 to 6 percent, severe if more than 6 percent.	Severe: clay texture; dense, compact subsoil.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Keith: KeA, KeB, KeC	Moderate: moderate permeability.	Moderate if slope is less than 6 percent; severe if slope is more than 6 percent: moderate permeability.	Slight	Moderate: moderate shrink-swell potential; ML or CL material.	Slight	Moderate: ML or CL material; low or moderate shrink-swell potential.
*Kyle: KlA, KlB, KlC, Kt, KuB For Pierre part of KuB, see Pierre series.	Severe: very slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent; severe if slope is more than 6 per cent: in places shale is below a depth of 60 inches.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
*Lakoa: LaF For Colby part, see Colby series.	Severe: steep.	Severe: slopes of more than 6 percent.	Severe: slopes of more than 25 percent in most places.	Severe: slopes of more than 25 percent in most places.	Severe: slopes of more than 25 percent in most places.	Severe: slopes of more than 25 percent in most places.
*Lismas: LcE, LeD For Pierre part of LeD, see Pierre series.	Severe: very slow permeability; less than 20 inches deep over shale.	Severe: less than 20 inches deep over shale; slopes of more than 6 percent in most places.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Loamy alluvial land: Lm. No interpretations; material too variable to be rated.						

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Fair: ML or CL material.	Unsuited:[2] possible sand and gravel below a depth of 60 inches.	Fair: limy; subject to soil blowing.	Slope is generally less than 2 percent on bottom land and terraces.	Good to poor stability and compaction characteristics; medium or high compressibility.	Moderate permeability; subject to flooding in some areas.	High available water capacity; moderate water intake rate; subject to flooding in some areas.	Nearly level bottom land and low terraces.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: surface layer 2 inches thick; dense, compact subsoil.	Shale at a depth of 20 to 40 inches; possible seepage in fractures	Fair or poor stability and compaction characteristics; high compressibility.	Dense, compact subsoil; very slow permeability.	Dense, compact subsoil; very slow permeability; possible salt accumulation.	Dense, compact subsoil; very slow permeability; shale at a depth of 20 to 40 inches.
Fair: ML or CL material.	Unsuited:[2] possible source of varying thickness below depth of 60 inches.	Good to a depth of 13 inches, fair below: limy.	Moderate permeability.	Good to poor stability and compaction characteristics; medium or high compressibility.	Nearly level to sloping; moderate permeability.	High available water capacity; moderately slow water-intake rate; deep root zone.	Nearly level to sloping; long, smooth slopes.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: clay texture.	Very slow permeability; low seepage.	High volume change; fair or poor stability and compaction characteristics; high compressibility.	Nearly level to sloping; very slow permeability.	Low or moderate available water capacity; very slow water intake rate.	Very slow permeability; long, smooth slopes in most places.
Poor: slopes of more than 25 percent in most places.	Unsuited [2]_____	Poor: slopes of more than 15 percent in most places.	Steep; possible seepage in fractures in bedrock.	Limited material; steep; many stones.	Steep_____	Steep_____	Steep.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: clay texture.	Less than 20 inches deep over shale; possible seepage in fractures.	Limited material; high volume change; fair or poor stability; high compressibility.	Sloping to moderately steep; shallow over shale.	Shallow over shale; very low available water capacity; sloping to moderately steep.	Shallow over shale; sloping to moderately steep.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Lohmiller: LnA, LnB	Severe: slow permeability.	Slight or severe: subject to flooding in some areas.	Slight or severe: subject to flooding in some areas.	Severe: high shrink-swell potential.	Moderate or severe: silty clay loam texture; subject to flooding in some areas.	Severe: high shrink-swell potential.
Lo	Severe: slow permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: high shrink-swell potential; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Lohmiller variant: Ls	Severe: slow permeability; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: high shrink-swell potential; subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Manter: MaA, MaB	Slight [3]	Severe: moderately rapid permeability.	Slight	Slight or moderate: SM or ML material.	Severe: moderately rapid permeability.	Slight or moderate: SM or ML material.
Manvel: McA, McB	Severe: moderately slow permeability.	Slight or moderate if slope is less than 2 percent; moderate if slope is 2 to 6 percent: CL or ML material.	Slight	Moderate: moderate shrink-swell potential; ML or CL material.	Moderate: silty clay loam texture.	Severe: AASHO Group Index more than 8.
Marsh: Mh. No interpretations; material too variable to be rated.						
Mawer: MlA, MlB	Slight [3]	Severe: rapid permeability in substratum.	Severe: very gravelly substratum.	Slight	Severe: rapid permeability in substratum.	Slight
McKenzie: Mn	Severe: very slow permeability; subject to ponding.	Severe: subject to ponding; slight if water is not likely to enter or damage lagoon.	Severe: subject to ponding; clay texture.	Severe: subject to ponding; high shrink-swell potential.	Severe: subject to ponding.	Severe: subject to ponding.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited [2]	Fair: silty clay loam texture; loamy.	Slope is generally less than 2 percent on bottom land and low terraces.	Medium or high compressibility; good to poor stability.	Slow permeability; subject to flooding in some areas.	Moderate or high available water capacity; slow water intake rate.	Nearly level bottom land and low terraces in most places.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: high salt content.	Subject to seepage; high salt content.	Medium or high compressibility; fair or poor stability.	High salt concentration; slow permeability.	High salt concentration.	High salt concentration; difficult to grow plants.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: silty clay loam texture; acid reaction.	Slopes of less than 2 percent on bottom land.	Medium or high compressibility; fair or poor stability.	Subject to flooding; slow permeability.	Subject to flooding.	Nearly level bottom land.
Good or fair: SM or ML material.	Poor: fines	Good	Moderately rapid permeability; high seepage.	Poor resistance to piping; moderate permeability when compacted.	Moderately rapid permeability; nearly level to gently sloping.	Moderate or high available water capacity; moderate water intake rate.	Moderately rapid permeability; fine sandy loam texture.
Poor: AASHO Group Index more than 8.	Unsuited [2]	Poor: very high lime content.	Moderately slow permeability; low seepage.	Medium or high compressibility; good to poor resistance to piping.	Nearly level to gently sloping; moderately slow permeability.	Moderate or high available water capacity; slow water intake rate.	Long, smooth slopes; nearly level to gently sloping.
Good	Good to poor: fines.	Good	Rapid permeability; high seepage.	High or moderate permeability when compacted; good or fair resistance to piping.	Rapid permeability in substratum; nearly level to gently sloping.	Low available water capacity; rapid water intake rate; moderately deep over sand and gravel.	Moderately deep over sand and gravel.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: clay texture; poorly drained.	Subject to ponding; good dugout site.	Fair or poor stability; high compressibility; high volume change.	Subject to frequent ponding; wet areas lower than available outlets.	Subject to frequent ponding.	Low, wet areas.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
*Midway: MoE, MrD. For Razor part of MrD, see Razor series.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Severe: high shrink-swell potential.	Moderate: silty clay loam texture; less than 20 inches deep over rippable bedrock.	Severe: high shrink-swell potential.
*Minatare: Ms. For Whitelake part, see Whitelake series.	Severe: very slow permeability; seasonal high water table.	Severe: rapid permeability in substratum.	Severe: dense, compact subsoil.	Severe: seasonal high water table; dense, compact subsoil.	Severe: seasonal high water table.	Severe: high susceptibility to frost heave; seasonal high water table.
Mine pits and dumps: Mt. No interpretations; material too variable to be rated.						
Minnequa: MuB, MuC	Severe: moderately slow permeability.	Severe: less than 40 inches deep over bedrock.	Moderate: less than 40 inches deep over rippable bedrock.	Moderate: moderate shrink-swell potential; less than 40 inches deep over rippable bedrock; ML or CL material.	Moderate: silty clay loam texture; less than 40 inches deep over rippable bedrock.	Severe: AASHO Group Index more than 8.
*Nevee: NeB, NsD. For Spearfish part of NsD, see Spearfish series.	Moderate: bedrock at a depth of 40 to 60 inches.	Moderate if slope is less than 6 percent; severe if slope is more than 6 percent: ML material; moderate permeability.	Slight if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent: bedrock rippable.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: ML material.	Moderate: 40 to 60 inches deep over rippable bedrock.	Moderate: ML material.
Oburn: ObA	Severe: very slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent.	Moderate: dense, compact subsoil; clay loam and sandy clay loam texture.	Moderate: moderate shrink-swell potential below 23 inches.	Slight	Severe: high shrink-swell potential.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: less than 20 inches deep over bedrock; difficult to revegetate.	Less than 20 inches deep over bedrock; possible seepage in fractures.	Limited material; medium or high compressibility.	Shallow over shale; sloping to moderately steep.	Shallow over shale; very low available water capacity; sloping to moderately steep.	Shallow over shale; short, irregular slopes.
Poor: high susceptibility to frost heave; seasonal high water table.	Good to poor: seasonal high water table.	Poor: surface layer 2 inches thick; dense, compact subsoil.	Seasonal high water table.	Moderate or high permeability when compacted; fair or poor resistance to piping.	Dense, compact subsoil; seasonal high water table.	Dense, compact subsoil; seasonal high water table.	Low, nearly level; dense, compact subsoil.
Poor: AASHO Group Index more than 8.	Unsuited [2]_____	Poor: very high in lime content.	Bedrock at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; poor to good stability; medium or high compressibility.	Gently sloping to sloping; moderately deep over shale.	Moderately deep over shale; low or moderate available water capacity; moderately slow water intake rate; gently sloping to sloping.	Moderately deep over shale; gently sloping to sloping.
Fair: ML material.	Unsuited [2]_____	Good to a depth of 8 inches; fair below: limy.	Moderate permeability; possible seepage in bedrock fractures.	Poor stability and resistance to piping; moderate permeability when compacted.	Gently sloping to sloping; moderate permeability.	Moderate available water capacity; moderate water intake rate; gently sloping to sloping.	Moderate permeability; gently sloping to sloping.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: surface layer 10 inches thick; dense, compact subsoil.	Very slow permeability; low seepage.	Medium or high compressibility; fair to good stability.	Dense, compact subsoil; very slow permeability.	Dense, compact subsoil; very slow permeability; possible salt accumulation.	Dense, compact subsoil; very slow permeability.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Parshall: PaA	Slight [3]	Severe: moderate or moderately rapid permeability; receives runoff from adjacent slopes.	Severe: receives runoff from adjacent slopes.	Severe: receives runoff from adjacent slopes.	Severe: receives runoff from adjacent slopes.	Severe: receives runoff from adjacent slopes.
*Penrose: PeE, PmD. For Minnequa part of PmD, see Minnequa series.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent; ML or CL material; less than 20 inches deep over rippable bedrock.	Moderate: silty clay loam texture; less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent; ML or CL material; less than 20 inches deep over rippable bedrock.
Pierre: PrA, PrB, PrD	Severe: very slow permeability.	Slight if slope is less than 2 percent, moderate if 2 to 6 percent, severe if more than 6 percent.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Ralph: RaB	Severe: bedrock at a depth of 20 to 40 inches.	Severe: less than 40 inches deep over bedrock.	Moderate: less than 40 inches deep over rippable bedrock.	Moderate: less than 40 inches deep over rippable bedrock; CL material.	Moderate: less than 40 inches deep over rippable bedrock; clay loam texture.	Moderate or severe: AASHO Group Index of 5 to more than 8; ML or CL material.
Razor: RcA, RcB, RcC	Severe: bedrock at a depth of 20 to 40 inches.	Severe: less than 40 inches deep over bedrock.	Moderate: less than 40 inches deep over rippable bedrock.	Severe: high shrink-swell potential.	Moderate: silty clay loam texture; less than 40 inches deep over rippable bedrock.	Severe: high shrink-swell potential.
Redig: RdE	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent. [3]	Severe: moderately rapid permeability in substratum; slopes of more than 6 percent in most places.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: gravelly material.	Severe: high gypsum content.	Severe: gravelly material; high gypsum content.	Severe: AASHO Group Index more than 8; high gypsum content.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Good or fair: SM or ML material.	Poor: fines	Good	Moderately rapid or moderate permeability; high seepage.	Poor resistance to piping; moderate permeability when compacted.	Receives runoff from adjacent slopes; moderate or moderately rapid permeability.	Moderate or high available water capacity; moderately rapid water intake rate; subject to runoff from adjacent slopes.	Nearly level; in swales; moderate or moderately rapid permeability.
Poor: limited material; less than 20 inches deep over bedrock.	Unsuited [2]	Poor: very high lime content; less than 20 inches deep over bedrock.	Less than 20 inches deep over bedrock; possible seepage in fractures.	Limited material; medium to high compressibility.	Shallow over shale; sloping to moderately steep.	Shallow over shale; sloping to moderately steep.	Shallow over shale; sloping to moderately steep.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: clay texture.	Shale at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; fair or poor stability; high volume change.	Moderately deep over shale; very slow permeability; slopes.	Moderately deep over shale; very slow water intake rate; very low or low available water capacity.	Moderately deep over shale; very slow permeability.
Fair or poor: AASHO Group Index of 5 to more than 8.	Unsuited [2]	Good	Bedrock at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; medium or high compressibility; fair stability.	Moderately deep over bedrock; moderate permeability; gently sloping	Moderately deep over bedrock; low or moderate available water capacity; moderately slow water intake rate; gently sloping.	Moderately deep over bedrock; gently sloping.
Poor: high shrink-swell potential.	Unsuited [2]	Poor: firm; limy.	Bedrock at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; medium or high compressibility.	Moderately deep over shale; slow permeability.	Moderately deep over shale; low available water capacity; slow water intake rate; nearly level to sloping.	Moderately deep over shale; nearly level to sloping.
Poor: AASHO Group Index more than 8; high gypsum content.	Unsuited: high gypsum content.	Poor: coarse fragments; high gypsum content; slope.	High gypsum content; high seepage.	High gypsum content.	Gently sloping to moderately steep; moderate permeability.	Gently sloping to moderately steep; high gypsum content.	Gently sloping to moderately steep; short, irregular slopes.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Riverwash: Rh. No interpretations; material too variable to be rated.						
*Rock outcrop: RsF. Rock outcrop part too variable to be rated. For Spearfish part, see Spearfish series.						
Saline-Alkali land: Sa. No interpretations; material too variable to be rated.						
Saline alluvial land: Sb. No interpretations; material too variable to be rated.						
Satanta: ScA, ScB, ScC	Slight	Moderate if slope is less than 6 percent; severe if slope is more than 6 percent: moderate permeability.	Slight	Moderate: moderate shrink-swell potential; CL or ML material.	Slight	Moderate: moderate shrink-swell potential.
Savo: SdA, SdB	Severe: moderately slow permeability.	Slight	Slight	Moderate or severe: moderate to high shrink-swell potential; CL or CH material.	Moderate: silty clay loam texture.	Severe: AASHO Group Index more than 8.
Schamber: SeE	Slight if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent. [3]	Severe: rapid permeability.	Severe: very gravelly material.	Slight if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent.	Severe: rapid permeability.	Slight if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent.
Scroggin Mapped only with Cabbart series.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: less than 40 inches deep over bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: less than 40 inches deep over rippable bedrock.	Moderate: less than 40 inches deep over rippable bedrock; ML or CL material.	Moderate: less than 40 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: ML or CL material.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Fair: moderate shrink-swell potential.	Unsuited:[2] possible source of varying thickness below a depth of 60 inches.	Good to a depth of 8 inches; fair below: clay loam texture.	Moderate permeability.	Medium or high compressibility; poor to good resistance to piping.	Nearly level to sloping; moderate permeability.	High available water capacity; moderately slow water intake rate; nearly level to sloping.	Nearly level to sloping; mostly long, smooth slopes; moderate permeability.
Poor: AASHO Group Index more than 8.	Unsuited:[2] possible source of varying thickness below a depth of 60 inches.	Fair to a depth of 7 inches; poor below: silty clay texture; very firm below depth of 7 inches.	Moderately slow permeability.	Medium or high compressibility.	Nearly level to gently sloping; moderately slow permeability.	Moderate or high available water capacity; slow water intake rate; nearly level to gently sloping.	Nearly level to gently sloping; moderately slow permeability.
Good	Good or poor: fines.	Poor: sand and gravel substratum below a depth of 10 inches.	Rapid permeability; high seepage.	Moderate or high permeability when compacted; good or fair resistance to piping.	Sloping to moderately steep; very shallow over sand and gravel.	Very shallow over sand and gravel; strongly sloping to moderately steep.	Very shallow over sand and gravel; short, irregular slopes.
Fair: bedrock at a depth of 20 to 40 inches; ML or CL material.	Unsuited [2]	Fair: limy; slopes.	Bedrock at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; medium or high compressibility.	Moderately deep over bedrock; gently sloping to strongly sloping.	Moderately deep over bedrock; gently sloping to strongly sloping.	Moderately deep over bedrock.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
*Shale land: Sg, ShF. Shale land part too variable to be rated. For Grummit part of ShF, see Grummit series.						
*Slickspots: SkB, SlB. Slickspots part too variable to be rated. For Demar part of SkB, see Demar series. For Wasa part of SlB, see Wasa series.						
Snomo: SmE. Shale land part too variable to be rated.	Moderate to severe: slopes of more than 8 percent in most places; shale at a depth of 40 to 60 inches.	Severe: slopes of more than 6 percent in most places.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Sorum: SnB	Slight: moderately rapid permeability in substratum.	Severe: moderately rapid permeability in substratum.	Moderate: clay loam texture in subsoil.	Moderate: moderate shrink-swell potential in subsoil; CL material.	Severe: moderately rapid permeability in substratum.	Moderate: moderate shrink-swell potential.
Spearfish. Mapped only with Nevee series and Rock outcrop.	Severe: less than 20 inches deep over bedrock.	Severe: less than 20 inches deep over bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent; less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent; ML or CL material; less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 25 percent; severe if slope is more than 25 percent; less than 20 inches deep over rippable bedrock.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent; ML or CL material; less than 20 inches deep over rippable bedrock.
Stetter: Sr, Ss	Severe: slow permeability; subject to flooding.	Severe: subject to flooding; slight if protected from flooding.	Severe: subject to flooding; clay texture.	Severe: subject to flooding; high shrink-swell potential.	Severe: subject to flooding; clay texture.	Severe: subject to flooding; high shrink-swell potential.
Stony steep land: St. No interpretations; material too variable.						

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: clay texture.	Shale substratum below a depth of 40 inches; possible seepage in fractures.	High volume change; fair or poor stability; high compressibility.	Gently sloping to moderately steep.	Gently sloping to moderately steep; erodible.	Clay texture: erodible.
Fair: moderate shrink-swell potential.	Poor: fines___	Good to a depth of 15 inches; poor below: dense, compact subsoil.	Moderately rapid permeability in substratum; high seepage.	Good to poor resistance to piping; low to moderate permeability when compacted.	Dense, compact subsoil; very slow permeability.	Dense, compact subsoil; very slow permeability; possible salt accumulation.	Dense, compact subsoil; very slow permeability.
Poor: limited material; less than 20 inches deep over bedrock.	Unsuited [2]_____	Poor: limy; less than 20 inches deep over bedrock; difficult to vegetate.	Less than 20 inches deep over bedrock; possible seepage in fractures.	Limited material; medium or high compressibility; poor to good resistance to piping.	Shallow over shale; sloping to steep in places.	Shallow over bedrock; sloping to steep in places.	Shallow over bedrock; sloping to steep in places; mostly short, irregular slopes.
Poor: high shrink-swell potential.	Unsuited:[2] possible source of varying thickness below a depth of 60 inches.	Poor: clay texture.	Slopes of less than 2 percent on bottom lands; subject to flooding; slow permeability.	High volume change; fair or poor stability; high compressibility.	Subject to flooding; slow permeability.	Subject to flooding; very slow water intake rate; low or moderate available water capacity.	Nearly level bottom land and low terraces; subject to flooding.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
*Swanboy: SuA, Sv. Slickspots part of Sv too variable to be rated.	Severe: very slow permeability.	Slight	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Terrace escarpments: Te. No interpretations; material too variable to be rated.						
*Twilight: TfD, TgC, ThD. For Assinniboine part of TgC, see Assinniboine series. For Blackhall part of ThD, see Blackhall series.	Slight: very soft bedrock at a depth of 20 to 40 inches.	Severe: less than 40 inches deep over bedrock; moderately rapid permeability.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: rippable bedrock at a depth of 20 to 40 inches.	Moderate if slope is less than 15 percent; severe if slope is more than 15 percent: rippable bedrock at a depth of 20 to 40 inches.	Severe: less than 40 inches deep over rippable bedrock; seepage.	Slight if slope is less than 9 percent; moderate if slope is 9 to 15 percent; severe if slope is more than 15 percent.
Twotop: ToB	Severe: very slow permeability.	Slight if slope is less than 2 percent; moderate if slope is 2 to 6 percent; severe if slope is more than 6 percent.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Vale: VaA	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Moderate: moderate shrink-swell potential; ML or CL material.	Slight	Moderate: moderate shrink-swell potential: ML or CL material.
*Wasa: WaB. Slickspots part too variable to be rated.	Severe: very slow permeability.	Slight if slope is less than 2 percent, moderate if 2 to 6 percent; 20 to 40 inches to nearly impervious shale.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Whitelake: WhA	Severe: seasonal water table.	Severe: rapid permeability in substratum; seasonal water table.	Severe: gravelly substratum.	Severe: seasonal water table.	Severe: rapid permeability in substratum.	Moderate or severe: moderate or high susceptibility to frost heave.

See footnotes at end of table.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor clay texture.	Very slow permeability; low seepage.	High volume change; fair or poor stability; high compressibility.	Very slow permeability; high salt concentration.	Very slow water intake rate; salt accumulation; low available water capacity.	Very slow permeability; clay texture; difficult to grow plants.
Fair: soft sandstone at a depth of 20 to 40 inches.	Poor: fines; sandstone at a depth of 20 to 40 inches.	Fair if slope is less than 15 percent; poor if slope is more than 15 percent: 8 to 16 inches thick; limy below.	Moderately rapid permeability; sandstone at a depth of 20 to 40 inches; high seepage.	Limited material; poor resistance to piping.	Gently sloping to strongly sloping in places; moderately deep over bedrock.	Moderately deep over bedrock; gently sloping to strongly sloping in places.	Moderately deep over bedrock; moderately rapid permeability; fine sandy loam texture.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: clay texture.	Very slow permeability; low seepage.	High volume change; fair or poor stability; high compressibility.	Very slow permeability; nearly level to sloping in places.	Very slow permeability; low or moderate available water capacity.	Very slow permeability; clay texture; nearly level to sloping in places.
Fair: moderate shrink-swell potential; ML or CL material.	Unsuited: [2] possible source of varying thickness below a depth of 60 inches.	Good to a depth of 9 inches; fair below: silty clay loam texture.	Moderate permeability.	Medium or high compressibility; poor or good resistance to piping.	Nearly level in places; moderate permeability.	High available water capacity; moderately slow water intake rate.	Nearly level in places; moderate permeability.
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: clay texture.	Shale at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; high volume change; high compressibility; fair or poor stability.	Moderately deep over shale; very slow permeability; high salt concentration.	Moderately deep over shale; very slow permeability; high salt concentration.	Moderately deep over shale; clay texture.
Fair or poor: moderate or high susceptibility to frost heave.	Poor: fines; seasonal water table.	Poor: 8 inches of fine sandy loam over dense, compact subsoil.	Seasonal water table; rapid permeability in substratum.	Poor resistance to piping; moderate permeability when compacted.	Dense, compact subsoil; slow permeability; possible salt accumulation.	Dense, compact subsoil; slow permeability; possible salt accumulation.	Nearly level in places; seasonal water table; dense, compact subsoil.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill [1]	Local roads and streets
Winler: WnB	Severe: very slow permeability.	Slight if slope is less than 2 percent, moderate if 2 to 6 percent, severe if more than 6 percent.	Severe: clay texture.	Severe: high shrink-swell potential.	Severe: clay texture.	Severe: high shrink-swell potential.
Zeona: ZeB	Slight [3]	Severe: rapid permeability.	Severe: fine sand texture.	Slight	Severe: rapid permeability.	Slight

[1] Onsite study is needed of the underlying strata, the water table, and the hazards of aquifer pollution and drainage into ground water in landfill deeper than 5 or 6 feet.

interpretations—Continued

Suitability as a source of—			Soil features affecting—				
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited [2]_____	Poor: clay texture.	Shale at a depth of 20 to 40 inches; possible seepage in fractures.	Limited material; high volume change; fair or poor stability; high compressibility.	Moderately deep over shale; very slow permeability.	Very slow permeability; moderately deep over shale.	Moderately deep over shale; very slow permeability; clay texture.
Good_____	Poor: fines___	Poor: fine sand; subject to soil blowing.	Rapid permeability; high seepage.	Poor resistance to piping; moderate permeability when compacted.	Fine sand texture; rapid permeability; short, choppy slopes.	Low available water capacity; very rapid intake rate.	Very susceptible to soil blowing; fine sand texture; rapid permeability.

[2] No sand and gravel within a depth of 60 inches.
[3] Possible pollution of ground water supply.

TABLE 7.—*Engineering*

[Tests were performed by the South Dakota Department of Highways in accordance

Soil name and location	Parent material	Depth from surface	Moisture-density data [1]	
			Maximum dry density	Optimum moisture
		Inches	*Lb per cu ft*	*Percent*
Blackhall fine sandy loam:				
1,400 feet W. and 2,150 S. of NE. corner sec. 15, T. 13 N., R. 9 E.	Sandstone of the Hell Creek Formation.	1–8	106	17
		8–26	104	16
Oburn fine sandy loam:				
2,580 feet W. and 1,000 feet N. of SE. corner sec. 9, T. 13 N., R. 9 E.	Sand, silt, and clay of the Hell Creek Formation.	9–20	107	18
		20–42	109	16
Ralph loam:				
1,400 feet S. and 700 feet W. of NE. corner sec. 29, T. 14 N., R. 6 E.	Silty, sandy, and clayey material of the Fox Hills Formation.	6–17	102	20
		17–27	105	18
Wasa clay:				
2,400 feet E. and 1,300 feet S. of NW. corner sec. 7, T. 10 N., R. 6 E.	Clay shale of the Pierre Formation.	6–20	94	26
		20–32	93	26

[1] Based on AASHO Designation: T 99–47, Method A (*1*).

[2] Mechanical analysis according to AASHO Designation: T 88–70 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters

test data

with standard procedures of the American Association of State Highway Officials]

Mechanical analysis [2]					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than 0.005 mm.			AASHO	Unified
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
					Percent			
		100	30	13	27	5	A-2-4(0)	SM-SC
		100	30	7	27	3	A-2-4(0)	SM
	100	99	64	31	38	16	A-6(8)	CL
		100	54	25	33	10	A-4(4)	ML-CL
		100	70	29	38	15	A-6(9)	ML-CL
		100	76	35	40	16	A-6(10)	ML-CL
100	99	84	81	67	67	35	A-7-5(20)	MH-CH
100	99	98	96	71	74	37	A-7-5(20)	MH

in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

TABLE 8.—*Engineering test data for soil samples taken along*

[Tests made by the South Dakota Department of Highways.

Soil series	Horizon	Number of samples tested	Mechanical analysis [1] of percentage less than 3 inches passing sieve—					
			No. 10 (2.0 mm.)		No. 40 (0.42 mm.)		No. 200 (0.074 mm.)	
			Range	Average	Range	Average	Range	Average
Absher	B	22	99–100	100	98–100	100	62–100	81
	C	29	98–100	100	97–100	99	69–99	84
Altvan	A	11	75–100	93	66–100	87	37–93	65
	B	28	76–100	93	52–100	84	32–93	63
	C	10	28–100	75	0–100	59	0–100	45
	2C	38	2–87	45	0–76	35	0–60	22
Arvada	B	6	79–100	94	71–100	90	57–100	82
	C	11	96–100	99	93–100	99	88–100	96
Baca	C	11	89–100	98	82–100	94	56–100	82
Barnum	C	16	56–100	89	46–100	84	14–89	52
Belfield	B	12	99–100	100	97–100	99	74–97	86
	C [7]	8	98–100	100	87–100	97	59–100	84
Bidman	B	8	86–100	96	76–100	91	64–99	81
	C	8	62–100	84	38–100	73	24–100	62
Cabbart	C	16	94–100	98	89–100	97	41–94	68
	C [7]	11	98–100	100	95–100	99	61–100	86
Canyon	C	8	67–100	89	59–100	84	11–89	50
	C [7]	34	95–100	98	92–100	96	37–100	72
Caputa	A	26	87–100	97	82–100	93	62–93	78
	B	166	85–100	97	79–100	93	61–100	81
	C	168	77–100	95	65–100	90	43–100	73
	2C	49	29–100	75	14–100	68	0–100	59
	C [7]	21	90–100	97	86–100	96	76–100	91
Colby	C	11	96–100	99	87–100	96	68–98	83
	C [7]	5	99–100	100	97–100	99	76–86	81
Demar	B	5	99–100	100	95–99	97	66–99	83
Dix	A	10	97–100	99	85–100	92	42–86	64
	B	8	94–100	98	81–98	90	45–91	68
	C	14	26–86	56	13–50	31	7–35	21
	2C	55	3–100	52	0–94	42	0–71	27
	C [7]	5	94–100	98	86–100	96	81–100	93
Epsie	C [7]	12	99–100	100	97–100	99	93–100	97
Glenberg	C	16	83–100	97	75–100	93	30–88	59
Grummit	C	16	85–100	96	78–100	94	64–100	85
	C [7]	26	97–100	99	95–100	98	85–100	93
Haverson	A	12	99–100	100	91–100	97	63–100	85
	C	44	----------	100	89–100	96	44–100	75
Hisle	B	6	98–100	100	95–100	98	82–100	92
	C	7	91–100	98	87–100	97	81–100	93
	C [7]	3	99–100	100	97–99	98	87–100	94
Keith	A	41	97–100	99	94–100	98	67–97	82
	B	77	97–100	99	94–100	98	71–100	86
	C	66	96–100	99	93–100	98	75–97	86

See footnotes at end of table.

proposed highway routes in Butte County and surrounding counties

Dashed lines indicate that soils were not tested for that property]

Liquid limit [2]		Plasticity index [3]		Classification			Estimated California bearing ratio [6]
Range	Average	Range	Average	AASHO [4] (Old index)	AASHO [5] (New index)	Unified	
Pct	*Pct*						
23–80	51	5–56	30	A–7–6(18)	A–7–6(26)	CH	3
26–75	50	7–53	29	A–7–6(18)	A–7–6(26)	CL	3
22–47	34	2–22	11	A–6(7)	A–6(6)	ML–CL	7
25–47	36	7–29	18	A–6(9)	A–6(9)	CL	6
15–53	34	1–30	15	A–6(3)	A–6(3)	SC	7
9–53	31	0–31	14	A–2–6(0)	A–2–6(0)	GC	----------
27–91	59	6–66	36	A–7–6(20)	A–7–6(31)	CH	2
15–92	53	3–58	30	A–7–6(19)	A–7–6(33)	CH	3
35–56	46	13–33	23	A–7–6(14)	A–7–6(20)	CL	4
18–34	26	1–16	8	A–4(3)	A–4(2)	CL	11
37–68	52	19–40	29	A–7–6(18)	A–7–6(27)	CH	3
45–59	52	18–39	28	A–7–6(18)	A–7–6(25)	CH	3
59–76	68	32–51	41	A–7–6(20)	A–7–6(36)	CH	1
37–86	61	18–56	36	A–7–6(16)	A–7–6(21)	CH	2
24–49	37	5–29	16	A–6(9)	A–6(10)	CL	6
29–56	43	3–40	21	A–7–6(13)	A–7–6(19)	CL	4
5–49	27	0–21	8	A–4(3)	A–4(1)	SM–SC	10
6–46	26	0–27	12	A–6(8)	A–6(6)	CL	11
34–55	44	15–31	22	A–7–6(14)	A–7–6(18)	CL	4
37–61	49	18–40	29	A 7 6(17)	A–7–6(24)	CL	3
31–63	47	14–41	27	A–7–6(16)	A–7–6(19)	CL	4
19–88	53	4–60	32	A–7–6(14)	A–7–6(16)	CH	3
49–92	71	28–67	37	A–7–6(20)	A–7–6(48)	CH	1
30–45	37	11–27	18	A–6(12)	A–6(15)	CL	6
29–42	36	12–23	17	A–6(11)	A–6(13)	CL	6
27–78	53	13–51	32	A–7–6(19)	A–7–6(28)	CH	3
19–58	38	0–29	12	A–6(7)	A–6(7)	ML–CL	6
22–50	36	7–22	14	A–6(9)	A–6(8)	CL	6
19–48	33	3–28	15	A–2–6(0)	A–2–6(0)	SC	----------
4–55	30	0–30	11	A–2–6(0)	A–2–6(0)	GC	----------
51–132	91	25–100	62	A–7–6(20)	A–7–6(67)	CH	1
45–56	51	23–36	29	A–7–6(18)	A–7–6(32)	CH	3
18–34	26	0–13	6	A–4(6)	A–6(1)	ML–CL	10
33–80	56	13–52	32	A–7–6(19)	A–7–6(30)	CH	3
44–84	64	34–59	40	A–7–6(20)	A–7–6(43)	CH	2
31–54	42	10–28	19	A–7–6(12)	A–7–6(17)	CL	5
38–46	42	15–26	20	A–7–6(13)	A–7–6(15)	CL	5
45–83	64	22–58	40	A–7–6(20)	A–7–6(40)	CH	2
29–77	53	12–52	32	A–7–6(19)	A–7–6(32)	CH	3
63–88	75	36–60	48	A–7–6(20)	A–7–6(52)	CH	1
25–43	34	3–21	11	A–6(9)	A–6(9)	ML–CL	7
32–47	39	8–27	17	A–6(11)	A–6(15)	CL	5
27–46	37	3–27	14	A–6(10)	A–6(13)	CL	6

TABLE 8.—*Engineering test data for soil samples taken along proposed*

Soil series	Horizon	Number of samples tested	Mechanical analysis [1] of percentage less than 3 inches passing sieve—					
			No. 10 (2.0 mm.)		No. 40 (0.42 mm.)		No. 200 (0.074 mm.)	
			Range	Average	Range	Average	Range	Average
Kyle	A	23	99–100	100	95–100	98	77–100	90
	B	192	91–100	99	88–100	97	80–100	92
	C	221	91–100	99	89–100	98	80–100	93
	C [7]	15	94–100	99	91–100	97	83–100	93
Lismas	C	9	98–100	99	96–100	98	91–99	95
	C [7]	42	97–100	100	95–100	99	86–100	95
Lohmiller	A	39	97–100	100	94–100	98	77–99	88
	C	158	84–100	97	79–100	87	64–100	87
Manter	B	7	98–100	99	64–100	84	12–60	36
	C	14	86–100	97	44–91	67	8–28	18
Manvel	A	13	91–100	98	87–100	95	77–94	85
	C	40	90–100	97	82–100	94	63–100	84
	C [7]	5	89–100	98	87–100	96	83–100	92
Midway	C	14	97–100	99	94–100	97	77–99	88
	C [7]	6	----------	100	95–100	98	78–100	90
Minatare	B	12	99–100	100	94–100	99	74–100	89
	C	6	99–100	100	85–100	96	51–100	82
Minnequa	A	12	97–100	99	92–100	97	72–96	84
	C	18	97–100	99	93–100	97	79–98	89
	C [7]	10	99–100	100	94–100	98	85–100	93
Nevee	C	64	87–100	97	83–100	95	60–100	81
	C [7]	48	62–100	91	57–100	89	44–100	80
Penrose	A	7	94–100	98	88–100	94	73–88	81
	C	10	67–100	94	62–100	89	46–100	79
	R	22	90–100	98	83–100	96	66–100	86
Pierre	A	9	97–100	99	92–100	97	76–100	89
	B	82	95–100	99	91–100	98	80–100	92
	C	172	98–100	100	92–100	98	83–100	93
	C [7]	62	99–100	100	97–100	99	88–100	96
Ralph	A	3	----------	100	99–100	100	84–95	90
	B	13	99–100	100	98–100	99	66–96	81
	C	17	95–100	100	93–100	98	51–98	74
	C [7]	5	----------	100	98–100	100	39–61	50
Razor	C	22	93–100	99	91–100	97	66–100	84
Redig	C	53	30–100	67	18–99	58	9–80	45
Satanta	A	9	95–100	99	88–100	95	32–83	57
	B	73	94–100	98	83–100	94	51–95	73
	C	37	79–100	96	65–100	91	38–99	69
	2C	10	40–100	84	25–100	75	0–79	39
Schamber	C	45	30–100	69	10–100	55	0–59	29
	2C	20	9–100	63	0–100	55	0–74	32
	C [7]	20	87–100	96	77–100	93	51–100	81
Spearfish	C	45	50–100	88	44–100	85	28–100	72
	C [7]	29	82–100	96	78–100	94	65–100	85
Stetter	C	7	98–100	100	96–100	99	78–100	92

See footnotes at end of table.

highway routes in Butte County and surrounding counties—Continued

Liquid limit [2]		Plasticity index [3]		Classification			Estimated California bearing ratio [6]
Range	Average	Range	Average	AASHO [4] (Old index)	AASHO [5] (New index)	Unified	
Pct	*Pct*						
36–68	52	16–42	28	A–7–6(18)	A–7–6(28)	CH	3
51–80	66	28–54	41	A–7–6(20)	A–7–6(43)	CH	2
49–87	68	27–58	42	A–7–6(20)	A–7–6(45)	CH	1
48–100	75	22–72	47	A–7–6(20)	A–7–6(51)	CH	1
54–107	81	32–78	54	A–7–6(20)	A–7–6(60)	CH	1
44–101	73	22–72	47	A–7–6(20)	A–7–6(51)	CH	1
30–62	46	8–35	21	A 7 6(14)	A–7–6(21)	CL	4
30–66	48	12–43	27	A–7–6(16)	A–7–6(25)	CL	4
17–31	24	0 16	6	A–4(0)	A–4(0)	SM–SC	12
4–27	16	0–7	2	A–2–4(0)	A–2–4(0)	SM	----------
35–52	44	11–25	17	A–7–6(12)	A–7–6(17)	ML–CL	4
33–58	46	15–34	24	A–7–6(15)	A–7–6(21)	CL	4
40–65	52	19–43	31	A–7–6(18)	A–7–6(31)	CH	3
37–63	50	15–43	29	A–7–6(18)	A–7–6(27)	CL	3
40–75	58	16–52	34	A–7–6(20)	A–7–6(34)	CH	2
38–60	49	14–37	25	A–7–6(16)	A–7–6(25)	CL	3
27–57	42	4–35	19	A–7–6(12)	A–7–6(16)	CL	5
33–48	40	8–26	16	A–6(11)	A–6(15)	ML–CL	5
32–60	46	15–34	24	A–7–6(15)	A–7–6(23)	CL	4
31–62	47	13–37	24	A–7–6(15)	A–7–6(25)	CL	4
23–41	32	6–20	12	A–6(9)	A–6–(9)	CL	8
18–48	33	3–27	14	A–6(10)	A–6(11)	CL	7
22–48	35	3–21	11	A–6(9)	A–6(9)	ML–CL	6
32–53	43	10–30	19	A–7–6(13)	A–7–6(16)	CL	4
31–56	43	12–35	23	A–7–6(14)	A–7–6(20)	CL	4
46–62	54	16–37	26	A–7–6(18)	A–7–6(27)	MH–CH	3
45–79	62	22–53	37	A–7–6(20)	A–7–6(39)	CH	2
47–84	65	24–58	41	A–7–6(20)	A–7–6(43)	CH	2
52–94	73	30–67	48	A–7–6(20)	A–7–6(53)	CH	1
27–32	29	4–11	7	A–4(8)	A–4(6)	ML–CL	9
28–43	36	8–22	14	A–6(10)	A–6(11)	CL	6
26–53	39	8–32	20	A–6(12)	A–6(14)	CL	5
21–40	30	3–24	13	A–6(4)	A–6(3)	SC	8
29–57	43	9–33	21	A–7–6(13)	A–7–6(18)	CL	4
26–64	45	11–41	26	A–7–6(7)	A–7–6(7)	GC	4
12–41	26	0–18	9	A–4(4)	A–4(3)	CL	11
27–45	36	11–26	18	A–6(11)	A–6(12)	CL	6
24–47	36	7 29	18	A–6(10)	A–6(10)	CL	6
13–50	31	0–32	13	A–6(2)	A–6(1)	SC	8
7–54	30	0–29	12	A–2–6(0)	A–2–6(0)	SC	----------
13–51	32	0–30	12	A–2–6(0)	A–2–6(0)	SC	----------
36–95	66	16–62	39	A–7–6(20)	A–7–6(34)	CH	2
20–45	33	2–26	13	A–7(9)	A–6(8)	CL	7
23–39	31	7–29	13	A–6(10)	A–6(10)	CL	8
40–90	65	21–64	42	A–7–6(20)	A–7–6(43)	CH	

TABLE 8.—*Engineering test data for soil samples taken along proposed*

Soil series	Horizon	Number of samples tested	Mechanical analysis [1] of percentage less than 3 inches passing sieve—					
			No. 10 (2.0 mm.)		No. 40 (0.42 mm.)		No. 200 (0.074 mm.)	
			Range	Average	Range	Average	Range	Average
Swanboy	A	28	99–100	100	95–100	98	85–100	93
	B	11	97–100	99	83–100	96	70–100	90
	C	98	93–100	99	85–100	96	75–100	90
	C [7]	8	99–100	100	94–100	99	91–100	97
Vale	A	5	91–100	97	85–100	93	54–99	77
	B	20	97–100	99	91–100	97	69–97	83
	C	22	68–100	93	60–100	89	47–100	79
	C [7]	5	93–100	99	88–100	97	78–100	91
Wasa	B	25	98–100	99	92–100	98	85–100	95
	C [7]	36		100	98–100	99	96–100	98

[1] Mechanical analyses according to the AASHO Designation T 88. Results by this procedure may differ somewhat from the results thxt would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from the calculations of grain-size fractions. The mechanical analyses data used in this table are not intended for naming textural classes of soil.

[2] Based on AASHO Designation T 89–60 (*1*).

terms used in table 7 are explained in the following paragraphs.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a solid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Table 8 contains results of engineering tests performed by the South Dakota Department of Highways on soils in Butte County and surrounding counties. These samples were taken along proposed highway routes.

The horizon column indicates the major horizons from which samples were taken. The samples were taken at depths that reflect distinct changes in color and texture and, therefore, may include material from more than one major horizon of a given series. Because this sampling differs from that used to collect the data in table 5, the range in properties given in this table is not necessarily the same as the range shown in table 5.

Several samples were tested for each major horizon of the selected soils. Table 8 shows the actual range and average value for each of several properties. The AASHO and Unified classifications in this table are based on average values.

Formation and Classification of the Soils

This section tells how the five factors of soil formation have affected the formation of soils in Butte County. It also explains the current system of soil classification and classifies all the soil series represented in the county according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes that act on material deposited or accumulated by geologic forces. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a soil that has genetically related horizons. Relief conditions the effects of climate and plant and animal life. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil profile. Ordinarily, a long time is required for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generaliza-

highway routes in Butte County and surrounding counties—Continued

Liquid limit [2]		Plasticity index [3]		Classification			Estimated California bearing ratio [6]
Range	Average	Range	Average	AASHO [4] (Old index)	AASHO [5] (New index)	Unified	
Pct	*Pct*						
46–75	60	21–42	31	A–7–6(20)	A–7–6(34)	MH–CH	2
31–134	82	2–103	52	A–7–5(20)	A–7–5(54)	CH	1
49–105	77	24–76	50	A–7–6(20)	A–7–6(52)	CH	1
49–158	104	22–128	75	A–7–6(20)	A–7–6(85)	CH	1
25–63	44	6–24	15	A–7–6(11)	A–7–6(12)	ML	4
27–47	37	10–26	18	A–6(11)	A–6(14)	CL	6
23–44	33	7–23	14	A–6(10)	A–6(10)	CL	7
23–42	33	6–23	15	A–6(10)	A–6(14)	CL	7
65–105	85	39–75	57	A–7–6(20)	A–7–6(63)	CH	1
73–98	86	45–71	58	A–7–6(20)	A–7–6(67)	CH	1

[3] Based on AASHO Designation T 91–54 (*1*).
[4] Based on AASHO Designation M 145–49 (*1*).
[5] For new index based on AASHO Designation M 145–661, see AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 v., illus. 1970.
[6] Estimated values based on relationships between California Bearing Ratio and liquid limit.
[7] Soft bedrock.

tions can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent material

Parent material is the disintegrated and partly weathered rock from which soil has formed. It determines many of the chemical and physical characteristics of the soil, such as color, texture, reaction, and consistence. Some of the soils of Butte County, for example, Winler and Twilight soils, formed in material weathered from the underlying geologic formations, and some, such as Stetter and Zeona soils, formed in material transported by wind and water. Some kinds of parent material are slow to show the effects of the other four factors of soil formation. The process of soil formation progresses faster in the more friable loamy and silty parent material because more changes take place, and the horizons are more distinct.

Eleven major geologic formations (*4*, *7*) are at or near the surface in Butte County, and several other formations of minor significance also are present. These formations greatly influence the kinds of soils in the county (fig. 25). In age, they range from the lower Spearfish Formation of the Permian Series to the Hell Creek Formation of the Upper Cretaceous Series. The formations are exposed in bands of varying width that extend in a general northwest to southwest direction across the county. This pattern of exposure is a result of the Black Hills uplift and subsequent erosion cycles (*2*).

The Spearfish Formation consists of red sandy shale, soft sandstone, and siltstone. It contains layers of gypsum and thin layers of limestone. Nevee and Spearfish soils inherit many of their characteristics from the Spearfish Formation.

The Sundance Formation is immediately above the Spearfish Formation. It is interbedded greenish-gray shale and fine-grained sandstone that contains thin lenses of limestone. Canyon and Colby soils formed in material weathered from the Sundance Formation. Discontinuous exposures of green to maroon shale of the Morrison Formation appear above the Sundance Formation in places.

A conspicuous feature known as the Dakota Hogback forms the outer rim of the Black Hills uplift. Formations of the Dakota, or Inyan Kara Group, which is in the Lower Cretaceous Series, are exposed on this ridge. Lakota Sandstone and Fall River Sandstone are the main formations of this group in Butte County. The Lakota Formation is a coarse, hard, crossbedded, mostly buff to gray sandstone. The Fall River Formation is a massive, crossbedded, ripple-marked, iron-stained sandstone interbedded with thin beds of sandy shale and siltstone. Butche and Lakoa soils formed in material weathered from these two formations. Less extensive are exposures of gray to purple Fuson Shale, which contains thin lenses of sandstone. Midway and Razor soils are associated with the exposures of Fuson Shale.

Exposures of the Graneros Formation extend away from the Dakota Hogback on to the plains. This formation consists of three distinct parts, which are, from the lower part to the upper part, Skull Creek Shale, Mowry Shale, and Belle Fourche Shale. The Skull Creek Shale is a dark-gray, fissile shale; the Mowry Shale is a dark brownish-gray,

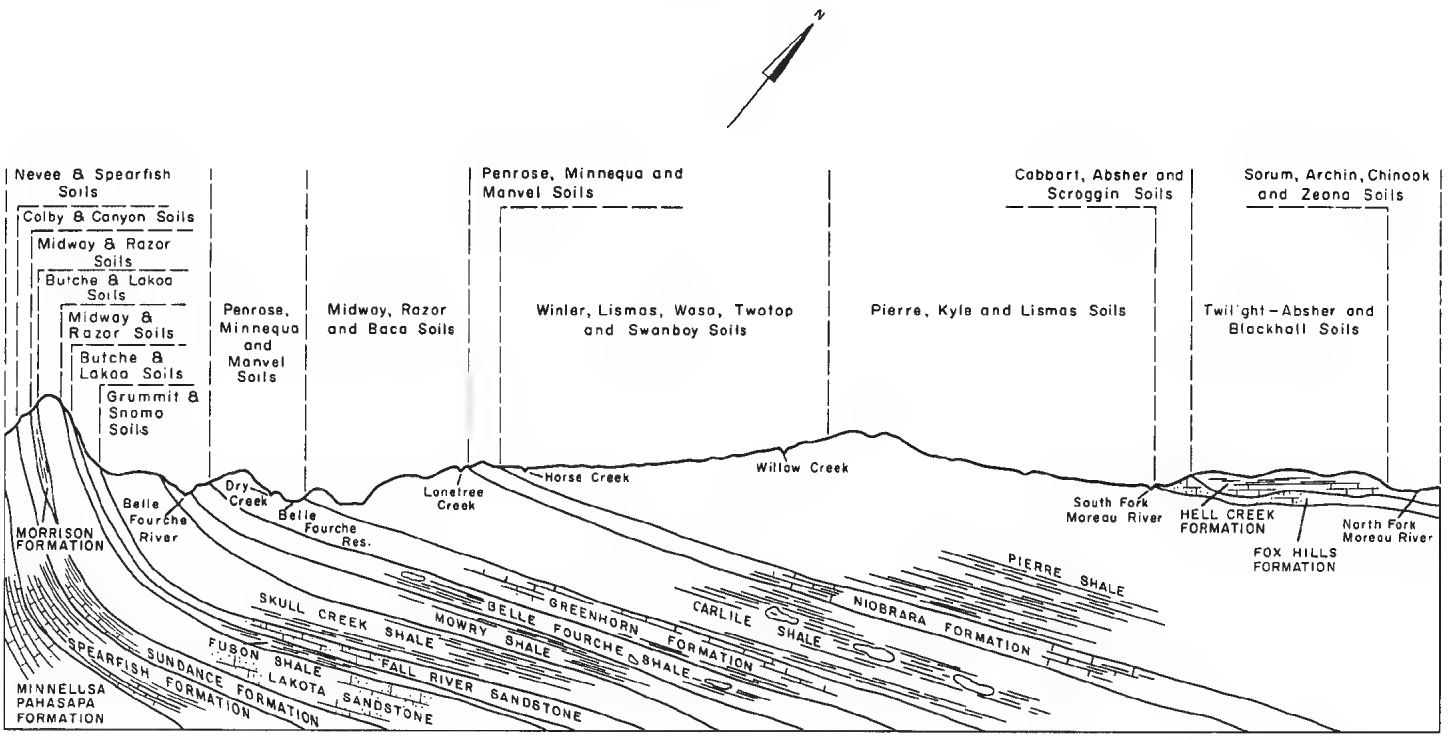

***Figure 25.*—Cross section from southwest corner to northeast corner of Butte County showing relationship of major soils to geologic formations.**

hard and brittle shale that weathers to light gray; and the Belle Fourche Shale is a dark-gray, fissile shale. These shales are strongly acid or extremely acid in reaction and have a high resistance to slaking. Mowry and Belle Fourche Shales contain many bentonite beds. Broadhurst, Graner, Grummit, and Snomo soils are among the soils that formed in material weathered from the Graneros Formation.

Several formations are exposed in narrow bands between those of the Graneros and Pierre Formations. The Greenhorn and Niobrara Formations are brownish-gray, calcareous shale and marl. The Greenhorn Formation commonly weathers to light gray and consists of thin beds of hard, brittle limestone in the lower part. The Niobrara Formation weathers to light yellowish gray. Manvel, Minnequa, and Penrose soils are the main soils that formed in material weathered from these formations.

Between the Greenhorn and Niobrara Formations is the Carlile Formation. It is light-gray shale in the upper part, sand and silty shale in the middle part, and dark-gray fissile shale in the lower part. Most of the Baca, Midway, and Razor soils in Butte County formed in material weathered from Carlile Shale.

The Pierre Formation is above the Niobrara Formation. It is gray shale that contains beds of sandstone and bentonite. In Butte County the lower part is a saline material from which Epsie soils formed. Interbedded in the lower part is a buff, medium- to fine-grained sandstone. Exposures of these beds account for the Cabbart and Scroggin soils mapped in the vicinity of Indian Creek. The upper part of the Pierre Formation is dark gray and appears almost black when moist. Lismas, Pierre, Wasa, and Winler soils are among the soils that inherit many of their characteristics from Pierre Shale.

Above the Pierre Formation are beds of sandy shale, sandstone, and siltstone of the Fox Hills and Hell Creek Formations. Blackhall, Cabbart, Scroggin, and Twilight soils are among the soils that formed in material weathered from these formations.

Alluvium, or material transported by water, can be either old or recent. Some of it was transported from a considerable distance, and some originates locally from adjacent sloping soils. Old alluvium is on high terraces and consists of stratified sandy, loamy, clayey, and gravelly material. Bidman, Caputa, Redig, and Satanta soils formed in old alluvium. Alluvium of Recent age is on bottom land and low terraces. Glenberg, Hanly, Haverson, Lohmiller, and Stetter soils are examples of soils that formed in this material.

Small areas of eolian sand occur in the northeastern part of the county. The Zeona soils formed in this loose sandy material that has been deposited or worked by wind.

Climate

Butte County has a continental type climate generally characterized by cold winters and hot summers. This kind of climate promotes moderately slow soil formation. The climate of Butte County is described in detail in the section "General Nature of the County."

The climate is fairly uniform throughout the county. The average annual precipitation ranges from about 15 inches in the south-central part to about 13 inches in the northern part. The average annual temperature ranges from about 44° F. in the northern part to about 47° in the southern part. The present climate is presumably similar to that under which the soils formed; consequently, climate alone does not account for local differences among the soils. Its effects are modified by the effects of the other four factors of soil formation.

Plant and animal life

Grasses, shrubs, trees, animals, insects, earthworms, bacteria, and fungi live on and in the soils and are active in the processes of soil formation. Plant growth affects soil formation by furnishing organic matter, by absorbing plant nutrients and water, by producing roots, and by supplying cover to the surface. The activity of micro-organisms is as important as plant growth in the formation of soils. Together they form the organic-matter cycle of the soil. Plants furnish the organic matter, and the micro-organisms decompose it and by so doing affect the chemistry of the soil. The other factors of soil formation have had a role in determining the kind and amount of plants and micro-organisms on and in the soil.

Nearly all of Butte County, except for small areas in the Dakota Hogback and the Graneros Shale area, was originally covered by grasses. Most areas still have a cover of native mid and short grasses. The density of cover, however, is quite variable because it is significantly affected by the interaction of the other factors of soil formation, particularly relief and parent material. Relief in many places determines the amount of rainfall that percolates into the soil. The steeper soils, such as Blackhall, Butche, Cabbart, Midway, and Penrose, lose much rainfall through runoff. These soils have less dense grass cover and consequently have thinner horizons formed by accumulation of organic matter. Nearly level soils, and particularly soils that have concave slopes, retain most of the rainfall and often receive additional runoff from surrounding slopes. These soils, such as Assinniboine, Keith, Manter, and Parshall soils, have dense grass cover and moderately thick to thick horizons formed by accumulation of organic matter.

Also, parent material affects the density of vegetative cover. The Epsie soils have very sparse cover because the parent material is highly saline. The vegetation in about 40 percent of the county is almost entirely mid grasses, because the very fine texture and dense consistence of the Swanboy, Twotop, Wasa, and Winler soils have restricted the plant growth on these soils. The density of grass cover on these soils fluctuates from very sparse stands during periods of extreme drought to highly dense stands during periods of more than average rainfall. The amount of organic-matter accumulation has been retarded by the physical characteristics of these soils.

Trees have had a role in the formation of some soils, such as Lakoa and Snomo soils. Trees grow naturally in areas where rainfall is higher than in grasslands, where more efficient use is made of the available rainfall, or where adequate moisture reaches depths greater than those generally reached by grass roots. If moisture penetrates to a sufficient depth for the deep roots of trees, grasses give way to the trees. Under forest vegetation, plant nutrients, lime, and clay are translocated to greater depths than under grass vegetation. Also, the surface horizon of forest soils lacks the organic-matter content of grassland soils because trees do not have the dense, fibrous root systems of grasses. Thus, soils that formed under forest vegetation have distinctly different horizonation than soils that formed under grasses. Lakoa and Snomo soils are suited to forest vegetation, mainly because their slopes face away from the sun, and they have a lower rate of evaporation.

Trees are also common along many of the streams throughout the county. The "moist stringer" effect, which is common along watercourses, is responsible for the difference in vegetation among some soils that have similar profile characteristics. Glenberg, Haverson, Lohmiller, and Stetter soils are examples of soils that have differences in vegetation caused by the "moist stringer" effect.

The activity of animal life varies, depending on the nature of the soil material. Very little activity takes place on the very fine textured soils, such as Twotop and Winler soils. Animals, such as prairie dogs, burrowing animals, and earthworms, are active in such loamy and silty soils as Cabbart, Canyon, Colby, and Ralph soils.

Man has played an important role in the formation of some soils. The A and B horizons in some fields have been mixed together by tillage, or the erosion resulting from tillage has thinned the A horizon. The A horizon of soils that have a thin A horizon, such as Baca and Razor soils, is often quite different in texture and color, depending on whether the soil has been cultivated or left in native grasses. Also, the application of irrigation water has altered such soil characteristics as reaction, color, and structure. Another alteration that is attributed to man is seepage in the irrigated parts of the county caused by improper irrigation practices.

Relief

Relief influences soil formation through its effect on drainage and runoff. Blackhall, Butche, Lismas, Midway, Penrose, and Spearfish soils are examples of steep soils that lose much rainfall through runoff. On such soils, natural erosion takes place nearly as rapidly as the parent material weathers, and soil development progresses at a very slow rate. If the slope is gentle, runoff is slower and more water enters the soils. This results in deeper moisture penetration, and in turn, lime and other soil nutrients are leached to deeper depths. Also, clay is moved downward and soils that have very distinct horizonation form. Assinniboine, Baca, Boneek, Ralph, Savo, and Vale soils are examples. If the relief causes water to pond, such soils as the McKenzie soil form.

Time

The length of time that soil material has been exposed to the other four factors of soil formation is reflected in the kinds of soil that form. The age of the parent material does not necessarily reflect the degree of soil formation that has taken place. For example, Cabbart and Ralph soils formed in parent material of the same age but differ greatly in the degree of horizonation that has taken place. The Cabbart soil is steep and shows very little profile formation because natural erosion has removed material almost as fast as it weathered from the parent material. Conversely, the Ralph soil is gently sloping and shows distinct horizonation, which indicates that the material has been in place and has been exposed to the factors of soil formation for a much longer time than that of the Cabbart soil.

The oldest soils are on parts of the landscape that have been stable for the longest time. In Butte County, these parts are the high terraces on which Bidman and Caputa soils formed. The well-developed genetic horizons of these soils reflect the long period of time that soil formation has taken place in them. The youngest soils are those in which natural erosion takes place nearly as rapidly as weathering of the parent material or are alluvial soils, which receive new material each time the area is flooded. Butche and Spearfish soils are examples of young soils that are subject to active natural erosion, and Glenberg and Haverson soils are examples of young alluvial soils.

Formation of Horizons

The processes that take place in the formation of soil horizons are the accumulation of organic matter, the leaching of calcium carbonates and bases, the formation and translocation of silicate clay minerals, the reduction and transfer of iron, and the deflocculation and dispersion of clay minerals. One or more of these processes have been active in the formation of horizons in the different soils of Butte County.

Organic matter accumulates as plant residue decomposes. This process is generally most evident in the A horizon. The amount of organic-matter accumulation is small or moderate in the soils in Butte County. Blackhall, Broadhurst, Butche, Cabbart, Canyon, Glenberg, and Haverson soils have small amounts of organic-matter accumulation, and Assinniboine, Belfield, Keith, Manter, and Satanta soils have moderate amounts.

The depth of leaching of carbonates and bases depends upon such characteristics as slope, texture, amount of carbonates and bases in the parent material, and age. Steep soils, such as Cabbart and Blackhall soils, have had little if any leaching of carbonates. Carbonates have been leached to a greater depth in the sandy Assinniboine and Chinook soils than in the clayey Baca and Kyle soils. The carbonates have not been leached from the younger alluvial soils, such as Barnum, Glenberg, and Haverson soils.

The formation and translocation of silicate clay minerals is evident in many of the soils of Butte County. The amount of clay minerals in a soil profile is determined by the parent material, but the amount of clay varies from one soil horizon to another. Clay minerals are generally eluviated from the A horizon and illuviated in the B horizon as clay films on the ped faces and in the pores and root channels. Altvan, Assinniboine, Bidman, Caputa, Keith, Ralph, and Savo soils have distinct horizons of clay accumulation.

The reduction and transfer of iron is associated mainly with the wetter, more poorly drained soils. This process is called gleying. The McKenzie soil shows reduction and transfer of iron.

The deflocculation and dispersion of clay minerals is the process responsible for the formation of the claypan soils in Butte County. This process is called solonization. In this process, the B horizon has a loss of calcium, which acts as a flocculating agent, and an accumulation of sodium, which acts as a dispersing agent. The horizon formed in this process is called a natric horizon. The accumulation of sodium causes this horizon to become sticky, jellylike, and impenetrable to water. The Absher, Archin, Arvada, Hisle, Minatare, and Sorum soils are soils in which the solonization process has been active.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison of large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*5*, *9*). In table 9, the soil series of Butte County are classified according to the current system.

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. Classes of the current system are briefly defined in the following paragraphs.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols,

TABLE 9.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Absher	Fine, montmorillonitic	Borollic Natrargids	Aridisols.
Alice	Coarse-loamy, mixed, mesic	Aridic Haplustolls	Mollisols.
Altvan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Aridic Argiustolls	Mollisols.
Archin	Fine-loamy, mixed	Borollic Natrargids	Aridisols.
Arvada	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Assinniboine	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Baca	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Barnum	Fine-loamy, mixed (calcareous), mesic	Ustic Torrifluvents	Entisols.
Belfield	Fine, montmorillonitic	Glossic Natriborolls	Mollisols.
Bidman	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Blackhall	Loamy, mixed (calcareous), frigid, shallow	Ustic Torriorthents	Entisols.
Boneek	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Broadhurst	Very fine, montmorillonitic, acid, mesic	Ustertic Torriorthents	Entisols.
Butche	Loamy, mixed, nonacid, mesic	Lithic Ustic Torriorthents	Entisols.
Cabbart	Loamy, mixed (calcareous), frigid, shallow	Ustic Torriorthents	Entisols.
Canyon	Loamy, mixed (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Caputa	Fine, mixed, mesic	Aridic Argiustolls	Mollisols.
Chinook	Coarse-loamy, mixed	Aridic Haploborolls	Mollisols.
Colby	Fine-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Demar	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Dix	Sandy-skeletal, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Epsie	Clayey, montmorillonitic (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Glenberg	Coarse-loamy, mixed (calcareous), mesic	Ustic Torrifluvents	Entisols.
Graner	Very fine, montmorillonitic, acid, mesic	Ustic Torriorthents	Entisols.
Grummit	Clayey, montmorillonitic, acid, mesic, shallow	Ustic Torriorthents	Entisols.
Hanly	Sandy, mixed, frigid	Ustic Torrifluvents	Entisols.
Haverson	Fine-loamy, mixed (calcareous), mesic	Ustic Torrifluvents	Entisols.
Hisle	Fine, mixed, mesic	Ustollic Natrargids	Aridisols.
Keith	Fine-silty, mixed, mesic	Aridic Argiustolls	Mollisols.
Kyle	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Lakoa	Fine-loamy, mixed	Typic Eutroboralfs	Alfisols.
Lismas [1]	Clayey, montmorillonitic, (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Lohmiller	Fine, montmorillonitic (calcareous), mesic	Ustic Torrifluvents	Entisols
Manter	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Manvel	Fine-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Mawer	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
McKenzie [2]	Fine, montmorillonitic (calcareous), frigid	Typic Haplaquepts	Inceptisols.
Midway	Clayey, montmorillonitic (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Minatare [3]	Fine, mixed, mesic	Aquic Natrargids	Aridisols.
Minnequa	Fine-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Nevee	Coarse-silty, mixed (calcareous), mesic	Ustic Torriorthents	Entisols.
Oburn	Fine, montmorillonitic	Borollic Natrargids	Aridisols.
Parshall	Coarse-loamy, mixed	Pachic Haploborolls	Mollisols.
Penrose	Loamy, mixed (calcareous), mesic	Lithic Ustic Torriorthents	Entisols.
Pierre	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Ralph	Fine-silty, mixed	Aridic Argiborolls	Mollisols.
Razor	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Redig	Fine-loamy, gypsic, mesic	Ustollic Calciorthids	Aridisols.
Santanta	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Savo	Fine, mixed, mesic	Aridic Argiustolls	Mollisols.
Schamber	Sandy-skeletal, mixed, mesic	Ustic Torriorthents	Entisols.
Scroggin	Fine-silty, mixed (calcareous), frigid	Ustic Torriorthents	Entisols.
Snomo	Very fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Sorum	Fine-loamy, mixed	Aridic Natriborolls	Mollisols.
Spearfish	Loamy, mixed (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Stetter	Fine, montmorillonitic, nonacid, mesic	Ustertic Torrifluvents	Entisols.
Swanboy	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Twilight	Coarse-loamy, mixed	Borollic Camborthids	Aridisols.
Twotop	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Vale	Fine-silty, mixed, mesic	Aridic Argiustolls	Mollisols.
Wasa	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Whitelake	Fine-loamy, mixed, mesic	Typic Natrustolls	Mollisols.
Winler	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Zeona	Mixed, frigid	Ustic Torripsamments	Entisols.

[1] Lismas soils in Butte County are taxadjuncts to the Lismas series because they are not calcareous in all parts above the shale.

[2] McKenzie soils in Butte County are taxadjuncts to the McKenzie series because they have soil temperatures greater than 47° F., which is higher than is defined as the range for the series.

[3] Minatare soils in Butte County are taxadjuncts to the Minatare series because they have a thinner B2t horizon and generally are coarser textured throughout than is defined as the range for the series.

Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different kinds of climate. The five soil orders in Butte County are Entisols, Inceptisols, Aridisols, Mollisols, and Alfisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect mixing caused by shrinking and swelling.

Inceptisols most often are on young, but not recent, land surfaces; hence their name is derived from the Latin *inceptum*, which means beginning.

Aridisols are light-colored mineral soils that are high in bases and have well-expressed mineral genetic horizons. They derive their name from the Latin *aridus*, which means dry.

Mollisols formed under grass. They have a thick, dark-colored surface horizon called a mollic epipedon; hence, their name is derived from the Latin *mollis*, which means soft.

Alfisols are mineral soils that contain horizons of clay accumulation. Unlike the Mollisols, they do not have a thick, dark-colored surface layer.

SUBORDER.—Each order is divided into suborders, primarily on the basis of the characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences that result from climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is Fluvent (*Fluv*, meaning flood plain, and *ent*, from Entisols).

GREAT GROUPS.—Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 9, because it is the last word in the name of the subgroup. The names of great groups have three or four syllables. An example is Torrifluvent (*Torri*, meaning usually dry; *fluv*, meaning flood plain; and *ent*, from Entisols).

SUBGROUP.—Great groups are divided into subgroups, one that represents the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives in front of the name of the great group. An example is Aridic Argiustolls (an Argiustoll that is intergrading toward an Aridisol).

FAMILY.—Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. An example is the fine-silty, mixed, mesic family of Aridic Argiustolls. In this example *fine-silty* is the texture, *mixed* is the mineralogy, and *mesic* is the soil temperature.

General Nature of the County

Butte County was created in 1883 by an act of the Dakota Territory legislature. Its size changed several times before the present boundaries were established in 1909. Belle Fourche has been the county seat since 1895.

The expansion of small industry in the county has helped offset a decline in the farm and ranch population since 1930. The 1970 census lists the population of the county as 7,825. The population of Belle Fourche was 4,236, or more than half the total population. The rural population in 1970 was about 2,600.

Belle Fourche is a terminal point for the railroad and an important point for freight shipping. More than 17,000 cars originate from this shipping point. Bentonite, livestock, posts, and poles are the main freight items. Five trucking firms also operate out of Belle Fourche.

U.S. Highway 212 is the main east-west highway in the county. It intersects U.S. Highway 85, the main north-south highway, at Belle Fourche. State Highway 34 serves the southwestern part of the county, and State Highway 79 extends north and south through the town of Newell. A system of all-weather secondary roads connects all parts of the county with the population centers of Belle Fourche and Newell. Access to these roads from ranches in the sparsely populated parts of the county is by winding trails.

Livestock is shipped by truck or by rail to central markets or delivered by direct consignment to feeders. Some is sold in local sales barns at Belle Fourche and at Faith, St. Onge, and Sturgis in neighboring counties. Wheat and other grains are marketed at elevators in Belle Fourche and Newell and at Faith and Sturgis in neighboring Meade County.

Stripmining for bentonite provides employment for several hundred people, including those at bentonite plants at Belle Fourche and west of Belle Fourche at Colony, Wyoming. Also at Belle Fourche are a brick and tile factory, a natural gas company, a sawmill, a post and pole plant, grain elevators, and a wool warehouse.

Newell has a large wool warehouse, which handles more than 3 million pounds of wool annually. It also

is headquarters for the Belle Fourche Irrigation District and a rural electric cooperative.

Belle Fourche is the northern gateway for tourist traffic to the Black Hills. Another tourist attraction is the geographic center of the United States, which has been located in Butte County since Alaska joined the Union.

Climate[10]

Butte County has a continental type climate characterized by generally cold winters and hot summers. Precipitation ordinarily is light during winter and marginal for adapted crops during the growing season. The Black Hills lie immediately to the south of the county and possibly act as a precipitation shield for moisture flow from the south. The Belle Fourche Reservoir, about 10 miles long and 3 miles wide at its widest part, is in the southwestern part of the county and is used to irrigate the nearby farmland. The reservoir and the irrigated land possibly have a small effect on the climate in the immediate vicinity.

The climate summary for the county is based mostly on 58 years of weather observations taken from 1902 to 1965 near Newell, which is located in the south-central part of the county at an elevation of 2,870 feet mean sea level. The average annual precipitation is within about 1 inch of that of Newell in the southeastern part of the county, but is about 2 to 3 inches less in the northern and southwestern parts. The average annual temperature is expected to be about 2 to 3 degrees lower in the northern part of the county than in the southern part.

Temperatures in the county vary widely from summer to winter and occasionally from day to day. The temperature usually reaches 100° F. or higher in summer and drops to −20° or lower during the winter. A reading of 100° or higher can be expected on an average about once in June, twice in July, and twice in 3 years in August. The temperature can be expected to drop to −20° or lower on an average of twice in January, once in February, and once in 2 years in December. A −30° reading can be expected on an average of once in 3 years. The temperature drops to zero or lower on an average of about 27 days per year and falls to climb above zero during the day on an average of about 3 times per year.

Table 10 shows the chance of certain low temperatures occurring after specified dates in spring or before indicated dates in fall. For example, there is a 50-percent chance that a 32° temperature will occur on or after May 16. This is the same as saying that in about 5 years out of 10 a temperature of 32° or lower may be expected near Newell on May 16 or later. The date of a 50-percent chance is also the average date of the indicated temperature.

Similarly, there is a 30-percent chance that a temperature of 32 degrees will occur by September 10. This should be interpreted that on an average of 3 years out of 10 the temperature will be 32° or lower near Newell on or before this date. These figures refer to air temperature as measured in a standard instrument shelter. Soil and plant temperatures vary somewhat from the temperature of the free air.

Other temperature data are given by month in table 11. This table also shows precipitation and snowfall data recorded at the National Weather Service station at Newell.

The average annual precipitation near Newell is 15.47 inches. Of this, 12.12 inches, or 78 percent, falls during the growing season of April to September. During the 58 year period from 1908 to 1965, the annual precipitation ranged from 6.64 inches in 1911 to 28.04 inches in 1946. Thundershowers are the main source of rainfall during the growing season and vary widely in amount and intensity. A rainfall of 1 inch or more in 1 hour can be expected about once in 2 years, and 2 inches or more in 1 hour can be expected about once in 20 years. A 24-hour rainfall of 2 inches or more can be expected about once in 5 years, and 3 inches or more can be expected about once in 20 years.

Hail occasionally accompanies the thundershowers and can be expected about one to two times per year in any one location in the county. It is most frequent in June and July, but has fallen as early as March and as late as November.

A snow cover is important as winter protection for pasture and fall-seeded grain, but it may also be a hindrance to farm and ranch activities. The seasonal snowfall averages 21 inches, but has ranged from 10 inches during the 1920–1921 season to 66 inches during the 1949–1950 season. The strong wind that often accompanies snowfall causes drifts in sheltered areas, while open fields remain nearly bare.

Official observations of sunshine, relative humidity, and wind are not recorded at Newell. Data from Rapid City, S. Dak., Valentine, Nebr., and Bismarck, N. Dak., were used to estimate these conditions in Butte County. The sunshine averages about 62 percent of the daylight hours during the year. The greatest amount, about 70 percent, is received in July and August. The lowest amount, about 20 percent, is received in December.

Relative humidity generally varies appreciably from early morning to afternoon and, occasionally, from day to day. Averages range from about 40 percent in the afternoon to about 70 percent in early morning during summer and from about 60 percent in the afternoon to about 75 percent in early morning during winter. The passage of a cold front occasionally accompanies the replacement of a warm and humid air mass with a much colder and drier air mass.

Windspeed averages about 11 miles per hour, and wind is mainly from the northwest. Winds of 50 miles per hour or more can occur during any month, but are most likely to occur in summer during thunderstorms. During other months, strong winds may accompany the passage of a cold front or an intense low-pressure area. It is possible for a tornado to touch down in the county, but the probability of such a rare event is difficult to estimate.

The average annual evaporation from a Weather

[10] By WALTER SPUHLER, State climatologist, National Weather Service, Brookings, S. Dak.

TABLE 10.—*Probability of last freezing temperature in spring and first in fall*

[Prepared by William F. Lytle, South Dakota State University. Data recorded at Newell, 1908–65]

Probability	Dates for given probability and temperature					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
After a specified date in spring:						
90 percent	March 13	March 20	March 30	April 13	April 28	May 8.
70 percent	March 20	March 28	April 7	April 20	May 4	May 14.
50 percent	April 4	April 13	April 22	May 4	May 16	May 26.
30 percent	April 18	April 27	May 6	May 16	May 27	June 6.
10 percent	April 25	May 6	May 14	May 23	June 2	June 12.
Before a specified date in fall:						
10 percent	October 10	October 5	Spetember 22	September 12	September 3	August 20.
30 percent	October 18	October 12	September 30	September 20	September 10	August 29.
50 percent	November 2	October 25	October 14	October 4	September 24	September 14.
70 percent	November 15	November 6	October 28	October 17	October 6	September 29.
90 percent	November 23	November 13	November 5	October 25	October 13	October 7.

TABLE 11.—*Temperature and precipitation*

[Prepared by William F. Lytle, South Dakota State University. All data recorded at Newell, 1908–65]

Month	Temperature				Precipitation							
			Two years in 10 will have—					One year in 10 will have—			Average number of days with—	
	Average daily maximum	Average daily minimum	Average of the daily maximum temperature equal to or higher than—	Average of the daily minimum temperature equal to or higher than—	Average total	Maximum total	Minimum total	Less than—	More than—	Average total snowfall	Snowfall of 1 inch or more	Snow cover of 1 inch or more
	°F	°F	°F	°F	In	In	In	In	In	In		
January	29.5	5.7	40.1	−2.9	0.42	1.67	0.00	0.10	0.89	3.9	1	4
February	33.1	9.0	43.2	.9	.36	1.01	0	.08	.74	3.1	1	3
March	42.0	18.3	51.1	11.5	.72	2.42	.09	.18	1.42	4.7	2	3
April	57.0	31.3	63.6	27.0	1.57	5.45	.10	.42	3.04	2.3	1	1
May	67.4	41.9	73.5	38.6	2.74	9.35	.30	.71	5.39	.5	0	0
June	77.2	51.8	83.8	48.4	3.07	6.42	.29	1.06	5.56	0	0	0
July	86.7	57.8	92.0	54.8	2.13	6.52	.14	.60	4.09	0	0	0
August	85.2	55.4	89.6	52.6	1.34	5.35	.08	.38	2.58	0	0	0
September	74.1	44.9	80.2	41.0	1.27	5.95	0	.24	2.66	.1	0	0
October	61.7	33.4	69.1	29.2	.97	3.84	.01	.15	2.16	1.4	1	1
November	45.0	20.7	52.4	16.0	.52	2.82	0	.10	1.13	2.0	1	2
December	33.8	10.4	41.9	4.0	.36	1.28	0	.09	.73	3.1	1	4
Annual	57.7	31.7	60.4	29.9	15.47	[1] 27.37	[2] 6.64	9.91	21.74	21.1	8	17

[1] In 1923.
[2] In 1911.

Service Class A pan is about 57 inches, of which 44 inches, or 78 percent, evaporates from May to October. Average annual lake evaporation is about 40 inches.

Farming

Livestock ranching is the main farm enterprise in the county. The present trend is toward fewer and larger holdings. According to the 1964 South Dakota Agricultural Statistics (*6*), Butte County had 546 farms that covered a total of 1,325,917 acres of land. The average farm size was 2,428.4 acres. Of these 546 farms, 386 were classified as livestock farms, 119 as general farms, 47 as cash-grain farms, 15 as dairy farms, 5 as poultry farms, and 51 as miscellaneous and unclassified farms.

Livestock and livestock products accounted for an average of 88 percent of the total cash farm income for the period 1956–66. The number of livestock reported in the 1968 statistics were 46,000 head of cattle, 221,400 head of sheep and lambs, 1,700 head of hogs, and 15,600 chickens. The number of cattle has increased from a low of 10,600 head in 1937 to a high of 52,000 head in 1967. The number of sheep and lambs has shown considerable variation over the years, ranging from a low of 144,200 head in 1937 to a high of 393,000 head in 1943. The number of hogs has ranged from a low of 600 head in 1961 to a high of 8,200 head in 1944.

Crops have accounted for an average of 12 percent of the total cash farm income for the period 1956–66. The general trend has been away from farm income from cash crops since the abandonment of sugar beet production in 1964. Sugar beets accounted for 7.2 percent of the cash farm income for the period 1960–64, but none have been grown in the county since that date.

The major irrigated crops in the county are alfalfa, corn, barley, and edible beans. According to the crop census for the Belle Fourche Irrigation District for 1969, alfalfa hay was harvested from 21,628 acres, corn for grain from 6,301 acres, corn for silage and fodder from 4,967 acres, other hay from 3,429 acres, barley from 1,437 acres, and edible beans from 1,125 acres. Small acreages of rye, sorghum, wheat, and vegetable crops also were harvested. Irrigated pasture covered 7,849 acres. Acreage figures were not available for other parts of the county that were irrigated.

Alfalfa, winter wheat, spring wheat, and oats are the major dryland crops. According to the 1968 crop census, alfalfa hay was harvested from 8,730 acres, winter wheat from 6,500 acres, spring wheat from 3,000 acres, and oats from 3,500 acres. Small acreages were reported for rye, durum wheat, flaxseed, sorghum, barley, alfalfa seed, and sweetclover seed. Wild hay was harvested from 23,000 acres.

Information about the past history of cropping and livestock raising can be obtained from annual reports of the South Dakota Crop and Livestock Reporting Service (*6*).

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bentonite. A porous rock of clay minerals derived from weathered volcanic ash or tuff. It is used as a seepage retarder in the bottom of a water storage reservoir.

Blowout. An excavation produced by wind action in loose soil, usually sand.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climate, continental. Climate typical of great land masses. It is characterized by a great range of temperature occurring in parts of a continent which are not affected by nearness to the sea.

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Dispersion, soil. Deflocculation of the soil and its suspension in water.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Escarpment. A cliff or relatively steep slope separating level or gently sloping areas.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Hue. One of the three variables of color. The dominant spectral (rainbow) color; it is related to the dominant wavelength of the light.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Land leveling. The reshaping of the ground surface to make for a more uniform application of irrigation water.

Landscape. All the characteristics that distinguish a certain kind of area on the earth's surface and give it a distinguishing pattern, in contrast to other kinds of areas. Any one kind of soil is said to have a characteristic natural landscape, and under different uses it has one or more characteristic cultural landscapes.

Mapping unit. Areas of soil of the same kind outlined on the soil map and identified by a symbol.

Marsh. Periodically wet or continually flooded areas. Surface not deeply submerged. Covered dominantly with sedges, cattails, rushes, or other water-tolerant plants. Includes fresh-water and salt-water marshes.

Mine dumps. Areas of waste from mines, quarries, and smelters.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil series, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

Piping, soil. Subsurface erosion that causes the formation of tunnel-like cavities. The presence of such cavities or susceptibility to their formation can be, and frequently is, a limitation or hazard to building roads, erosion-control terraces, canals, and other structures across soils susceptible to piping.

Playa. A flat basin or sump area on the floor of an arid valley. The sediments left by flooding are generally fine or clayey, highly charged with salts or alkalis, and such areas are nearly devoid of vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Row crops. A crop planted in rows, generally 2 to 4 feet apart, so as to allow cultivation between rows during the growing seasons.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Savannah. An area of grassland usually flat and devoid of trees or containing only scattered trees and shrubs.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Shale. A sedimentary rock formed by the hardening of clay deposits.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulch. Stubble or other crop residues left on the soil, or partly worked into the soil, to provide protection from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Taxadjunct. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their usefulness or behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

Windbreak. Any shelter that protects from the wind. A vegetative windbreak is a strip of closely spaced trees and shrubs that is planted primarily to deflect wind currents and thereby reduce soil blowing, control snow drifting, conserve moisture, and protect crops, orchards, livestock, and buildings.

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 12.
Predicted yields of dryfarmed crops, table 2, page 84.
Predicted yields of irrigated crops, table 3, page 91.
Engineering, tables 5, 6, 7, and 8, pages 102 to 143.

Map symbol	Mapping unit	Page	Range site		Capability unit				Windbreak group
					Dryland		Irrigated		
			Name	Page	Symbol	Page	Symbol	Page	Number
AbA	Absher-Oburn complex, 0 to 3 percent slopes	13	----------	--	-------	--	-------	--	--
	Absher part	--	Thin Claypan	75	VIs-3	82	-------	--	10
	Oburn part	--	Claypan	75	IVs-2	80	-------	--	9
AbB	Absher-Oburn complex, 3 to 9 percent slopes	14	----------	--	VIs-3	82	-------	--	10
	Absher part	--	Thin Claypan	75	-------	--	-------	--	--
	Oburn part	--	Claypan	75	-------	--	-------	--	--
AeB	Absher-Slickspots complex, 0 to 9 percent slopes	14	----------	--	-------	--	-------	--	--
	Absher part	--	Thin Claypan	75	VIs-3	82	-------	--	10
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
AfB	Alice fine sandy loam, 2 to 6 percent slopes	14	Sandy	73	IVe-7	79	IIIe-4	89	5
AfC	Alice fine sandy loam, 6 to 9 percent slopes	15	Sandy	73	VIe-7	81	-------	--	10
AlA	Altvan loam, 0 to 2 percent slopes	15	Silty	73	IVs-1	80	IIs-2	88	6
AlB	Altvan loam, 2 to 6 percent slopes	15	Silty	73	IVe-2	78	IIIes-1	89	6
AnA	Archin-Slickspots complex, 0 to 3 percent slopes	16	----------	--	-------	--	-------	--	--
	Archin part	--	Claypan	75	IVs-2	80	-------	--	9
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
ArA	Arvada silt loam, 0 to 3 percent slopes	17	Thin Claypan	75	VIs-3	82	-------	--	10
AsA	Arvada-Slickspots complex, 0 to 3 percent slopes	17	----------	--	-------	--	-------	--	--
	Arvada part	--	Thin Claypan	75	VIs-3	82	-------	--	10
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
AtA	Assinniboine fine sandy loam, 0 to 3 percent slopes	18	Sandy	73	IVe-6	79	-------	--	5
BaA	Baca silty clay loam, 0 to 2 percent slopes	18	Clayey	74	IIIs-1	77	IIs-1	87	4
BaB	Baca silty clay loam, 2 to 6 percent slopes	19	Clayey	74	IVe-3	78	IIIe-1	88	4
Bd	Badland	19	----------	--	VIIIs-2	83	-------	--	--
Be	Barnum silt loam	20	Silty	73	IIIc-2	78	I-3	87	1
Bh	Barnum silt loam, channeled	20	Overflow	72	VIw-3	81	-------	--	10
BlA	Belfield-Oburn silt loams, 0 to 3 percent slopes	21	----------	--	IIIs-2	77	-------	--	--
	Belfield part	--	Clayey	74	-------	--	-------	--	4
	Oburn part	--	Claypan	74	-------	--	-------	--	9
BlB	Belfield-Oburn silt loams, 3 to 6 percent slopes	21	----------	--	-------	--	-------	--	--
	Belfield part	--	Clayey	74	IVe-9	79	-------	--	4
	Oburn part	--	Claypan	75	VIs-5	82	-------	--	10
BmA	Bidman loam, 0 to 3 percent slopes	22	Clayey	74	IIIs-2	77	-------	--	4
BmB	Bidman loam, 3 to 6 percent slopes	22	Clayey	74	IVe-9	79	-------	--	4
BrB	Bidman-Redig complex, 2 to 9 percent slopes	22	----------	--	-------	--	-------	--	--
	Bidman part	--	Clayey	74	IVe-9	79	-------	--	4
	Redig part	--	Thin Upland	74	VIe-3	80	-------	--	10

Map symbol	Mapping unit	Page	Range site		Capability unit				Windbreak group
					Dryland		Irrigated		
			Name	Page	Symbol	Page	Symbol	Page	Number
BsB	Boneek silt loam, 2 to 6 percent slopes	23	Silty	73	IIIe-1	77	-------	--	3
BsC	Boneek silt loam, 6 to 9 percent slopes	24	Silty	73	IVe-1	78	-------	--	3
BtB	Broadhurst clay, 0 to 6 percent slopes	24	Dense Clay	74	VIs-6	82	-------	--	10
BuD	Butche-Boneek complex, 6 to 25 percent slopes	25	----------	--	-------	--	-------	--	--
	Butche part	--	Shallow	74	VIs-1	81	-------	--	10
	Boneek part	--	Silty	73	IVe-1	78	-------	--	3
BvF	Butche-Rock outcrop complex, 25 to 50 percent slopes	25	----------	--	-------	--	-------	--	--
	Butche part	--	Shallow	74	VIIs-1	82	-------	--	10
	Rock outcrop	--	----------	--	VIIIs-1	83	-------	--	--
CaF	Cabbart loam, 25 to 40 percent slopes	27	Shallow	74	VIIs-1	82	-------	--	10
CbD	Cabbart-Lismas complex, 6 to 18 percent slopes	27	----------	--	VIs-1	81	-------	--	10
	Cabbart part	--	Shallow	74	-------	--	-------	--	--
	Lismas part	--	Shallow Dense Clay	75	-------	--	-------	--	--
CcF	Cabbart-Rock outcrop complex, 25 to 50 percent slopes	27	----------	--	-------	--	-------	--	--
	Cabbart part	--	Shallow	74	VIs-1	81	-------	--	10
	Rock outcrop	--	----------	--	VIIIs-1	83	-------	--	--
CgD	Cabbart-Scroggin loams, 6 to 25 percent slopes	28	----------	--	VIs-1	81	-------	--	10
	Cabbart part	--	Shallow	74	-------	--	-------	--	--
	Scroggin part	--	Thin Upland	74	-------	--	-------	--	--
ClF	Canyon-Colby complex, 25 to 50 percent slopes	28	----------	--	VIIs-1	82	-------	--	10
	Canyon part	--	Shallow	74	-------	--	-------	--	--
	Colby part	--	Thin Upland	74	-------	--	-------	--	--
CmA	Caputa loam, 0 to 2 percent slopes	29	Clayey	74	IIIc-1	77	-------	--	3
CmB	Caputa loam, 2 to 6 percent slopes	29	Clayey	74	IIIe-1	77	-------	--	3
CmC	Caputa loam, 6 to 9 percent slopes	29	Clayey	74	IVe-1	78	-------	--	3
CnA	Chinook fine sandy loam, 0 to 3 percent slopes	30	Sandy	73	IVe-6	79	-------	--	5
CoD	Colby-Canyon silt loams, 6 to 25 percent slopes	31	----------	--	VIe-3	80	-------	--	10
	Colby part	--	Thin Upland	74	-------	--	-------	--	--
	Canyon part	--	Shallow	74	-------	--	-------	--	--
DsA	Dix sandy loam, 0 to 3 percent slopes	32	Shallow to Gravel	75	VIs-4	82	IVse-1	90	10
EpD	Epsie clay, 3 to 25 percent slopes	32	Saline Upland	75	VIIs-3	82	-------	--	10
EsE	Epsie-Shale land complex, 9 to 45 percent slopes	33	----------	--	-------	--	-------	--	--
	Epsie part	--	Saline Upland	75	VIIs-3	82	-------	--	10
	Shale land	--	----------	--	VIIIs-2	83	-------	--	--
GgA	Glenberg fine sandy loam, 0 to 2 percent slopes	34	Sandy	73	IVe-6	79	IIe-3	87	2
GgB	Glenberg fine sandy loam, 2 to 6 percent slopes	34	Sandy	73	IVe-7	79	IIIe-4	89	2
Gh	Glenberg and Haverson soils	34	Overflow	72	VIw-3	81	-------	--	10
GnC	Graner clay, 3 to 25 percent slopes	35	Porous Clay	73	VIe-4	81	-------	--	10
GrE	Grummit clay, 3 to 25 percent slopes	36	Shallow	74	VIs-2	82	-------	--	10
Ha	Hanly loamy fine sand	37	Sands	73	VIe-8	81	-------	--	7
HeA	Haverson loam, 0 to 2 percent slopes	37	Silty	73	IIIc-2	78	I-3	87	1
HeB	Haverson loam, 2 to 6 percent slopes	37	Silty	73	IIIe-1	77	IIIe-3	89	1
HlB	Hisle loam, 0 to 9 percent slopes	38	Thin Claypan	75	VIs-3	82	-------	--	10

Map symbol	Mapping unit	Page	Range site		Capability unit				Windbreak group
					Dryland		Irrigated		
			Name	Page	Symbol	Page	Symbol	Page	Number
HsB	Hisle-Slickspots complex, 0 to 9 percent slopes	38	----------	--	-------	--	-------	--	--
	Hisle part	--	Thin Claypan	75	VIs-3	82	-------	--	10
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
KeA	Keith silt loam, 0 to 2 percent slopes	39	Silty	73	IIIc-1	77	I-2	87	3
KeB	Keith silt loam, 2 to 6 percent slopes	39	Silty	73	IIIe-1	77	IIIe-2	89	3
KeC	Keith silt loam, 6 to 9 percent slopes	39	Silty	73	IVe-1	78	-------	--	3
KlA	Kyle clay, 0 to 2 percent slopes	40	Clayey	74	IVs-3	80	IIIs-1	89	4
KlB	Kyle clay, 2 to 6 percent slopes	40	Clayey	74	IVe-3	78	IVes-1	90	4
KlC	Kyle clay, 6 to 9 percent slopes	40	Clayey	74	VIe-4	81	-------	--	10
Kt	Kyle clay, terrace	40	Clayey	74	IVs-3	80	IIIs-1	89	4
KuB	Kyle-Pierre clays, 0 to 6 percent slopes	40	Clayey	74	IVe-3	78	-------	--	4
LaF	Lakoa-Colby association, 9 to 50 percent slopes	41	----------	--	VIIe-1	82	-------	--	10
	Lakoa part	--	----------	--	-------	--	-------	--	--
	Colby part	--	Thin Upland	74	-------	--	-------	--	--
LcE	Lismas clay, 3 to 25 percent slopes	42	Shallow Dense Clay	75	VIs-2	82	-------	--	10
LeD	Lismas-Pierre clays, 3 to 18 percent slopes	42	----------	--	VIs-2	82	-------	--	10
	Lismas part	--	Shallow Dense Clay	75	-------	--	-------	--	--
	Pierre part	--	Clayey	74	-------	--	-------	--	--
Lm	Loamy alluvial land	42	Overflow	72	VIw-3	81	-------	--	10
LnA	Lohmiller silty clay loam, 0 to 2 percent slopes	43	Clayey	74	IIIc-2	78	I-1	86	1
LnB	Lohmiller silty clay loam, 2 to 6 percent slopes	43	Clayey	74	IIIe-1	77	IIIe-1	88	1
Lo	Lohmiller silty clay loam, saline	43	Saline Upland	75	VIIs-3	82	-------	--	10
Ls	Lohmiller silty clay loam, acid variant	44	Overflow	72	VIw-2	81	-------	--	10
MaA	Manter fine sandy loam, 0 to 2 percent slopes	44	Sandy	73	IVe-6	79	IIe-1	87	5
MaB	Manter fine sandy loam, 2 to 6 percent slopes	44	Sandy	73	IVe-7	79	IIIe-4	89	5
McA	Manvel silty clay loam, 0 to 2 percent slopes	45	Thin Upland	74	IVe-10	80	I-1	86	8
McB	Manvel silty clay loam, 2 to 6 percent slopes	45	Thin Upland	74	IVe-8	79	IIIe-1	88	8
Mh	Marsh	45	----------	--	VIIIw-1	83	-------	--	10
MlA	Mawer fine sandy loam, 0 to 2 percent slopes	46	Sandy	73	IVe-4	79	IIe-2	87	6
MlB	Mawer fine sandy loam, 2 to 6 percent slopes	46	Sandy	73	IVe-5	79	IVes-3	90	6
Mn	McKenzie clay	47	Closed Depression	73	VIs-3	82	-------	--	10
MoE	Midway silty clay loam, 6 to 25 percent slopes	47	Shallow	74	VIs-2	82	-------	--	10
MrD	Midway-Razor silty clay loams, 3 to 15 percent slopes	47	----------	--	-------	--	-------	--	--
	Midway part	--	Shallow	74	VIs-2	82	-------	--	10
	Razor part	--	Clayey	74	IVe-3	78	-------	--	4
Ms	Minatare-Whitelake complex	48	----------	--	-------	--	-------	--	--
	Minatare part	--	Saline Lowland	72	VIs-3	82	-------	--	10
	Whitelake part	--	Sandy	73	IVe-12	80	-------	--	5

Map symbol	Mapping unit	Page	Range site		Capability unit				Windbreak group
					Dryland		Irrigated		
			Name	Page	Symbol	Page	Symbol	Page	Number
Mt	Mine pits and dumps	48	----------	--	VIIIs-2	83	-------	--	10
MuB	Minnequa silty clay loam, 2 to 6 percent slopes	49	Thin Upland	74	IVe-8	79	IVes-2	90	8
MuC	Minnequa silty clay loam, 6 to 9 percent slopes	50	Thin Upland	74	VIe-3	80	-------	--	10
NeB	Nevee silt loam, 2 to 6 percent slopes	50	Thin Upland	74	IVe-8	79	IIIe-3	89	8
NsD	Nevee-Spearfish silt loams, 6 to 25 percent slopes	50	----------	--	VIe-3	80	-------	--	10
	Nevee part	--	Thin Upland	74	-------	--	-------	--	--
	Spearfish part	--	Shallow	74	-------	--	-------	--	--
ObA	Oburn loam, 0 to 3 percent slopes	51	Claypan	75	IVs-2	80	-------	--	9
PaA	Parshall fine sandy loam, 0 to 3 percent slopes	52	Sandy	73	IVe-6	79	-------	--	1
PeE	Penrose silty clay loam, 6 to 25 percent slopes	52	Shallow	74	VIs-1	81	-------	--	10
PmD	Penrose-Minnequa silty clay loams, 3 to 15 percent slopes	52	----------	--	-------	--	-------	--	--
	Penrose part	--	Shallow	74	VIs-1	81	-------	--	10
	Minnequa part	--	Thin Upland	74	IVe-8	79	-------	--	8
PrA	Pierre clay, 0 to 2 percent slopes	53	Clayey	74	IVs-3	80	-------	--	4
PrB	Pierre clay, 2 to 6 percent slopes	53	Clayey	74	IVe-3	78	-------	--	4
PrD	Pierre clay, 6 to 21 percent slopes	54	Clayey	74	VIe-4	81	-------	--	10
RaB	Ralph loam, 3 to 6 percent slopes	54	Silty	73	IIIe-1	77	-------	--	3
RcA	Razor silty clay loam, 0 to 2 percent slopes	55	Clayey	74	IIIs-1	77	IVes-2	90	4
RcB	Razor silty clay loam, 2 to 6 percent slopes	55	Clayey	74	IVe-3	78	IVes-2	90	4
RcC	Razor silty clay loam, 6 to 9 percent slopes	55	Clayey	74	VIe-4	81	-------	--	10
RdE	Redig clay loam, 9 to 25 percent slopes	56	Thin Upland	74	VIe-3	80	-------	--	10
Rh	Riverwash	56	----------	--	VIIIe-1	83	-------	--	10
RsF	Rock outcrop-Spearfish complex, 25 to 50 percent slopes	56	----------	--	-------	--	-------	--	--
	Rock outcrop	--	----------	--	VIIIs-1	83	-------	--	--
	Spearfish part	--	Shallow	74	VIIs-1	82	-------	--	10
Sa	Saline-Alkali land	57	----------	--	VIIIs-3	83	-------	--	--
Sb	Saline alluvial land	57	Saline Lowland	72	VIIs-9	83	-------	--	10
ScA	Satanta loam, 0 to 2 percent slopes	58	Silty	73	IIIc-1	77	I-2	87	3
ScB	Satanta loam, 2 to 6 percent slopes	58	Silty	73	IIIe-1	77	IIIe-2	89	3
ScC	Satanta loam, 6 to 9 percent slopes	58	Silty	73	IVe-1	78	-------	--	3
SdA	Savo silty clay loam, 0 to 2 percent slopes	59	Silty	73	IIIc-1	71	IIs-1	87	3
SdB	Savo silty clay loam, 2 to 6 percent slopes	59	Silty	73	IIIe-1	77	IIIe-1	88	3
SeE	Schamber loam, 6 to 25 percent slopes	60	Very Shallow	75	VIIs-7	83	-------	--	10
Sg	Shale land	60	----------	--	VIIIs-2	83	-------	--	--
ShF	Shale land-Grummit complex, 15 to 45 percent slopes	60	----------	--	-------	--	-------	--	--
	Shale land	--	----------	--	VIIIs-2	83	-------	--	--
	Grummit part	--	Shallow	74	VIs-2	82	-------	--	10
SkB	Slickspots-Demar complex, 0 to 6 percent slopes	61	----------	--	-------	--	-------	--	--
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
	Demar part	--	Claypan	75	IVs-2	80	-------	--	9

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Range site		Capability unit				Windbreak group
			Name	Page	Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Number
SlB	Slickspots-Wasa complex, 0 to 6 percent slopes	61	----------	--	-------	--	-------	--	--
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
	Wasa part	--	Dense Clay	74	VIs-6	82	-------	--	10
SmE	Snomo-Shale land complex, 3 to 25 percent slopes	62	----------	--	-------	--	-------	--	--
	Snomo part	--	Clay Savannah	74	VIe-4	81	-------	--	10
	Shale land	--	----------	--	VIIIs-2	83	-------	--	--
SnB	Sorum fine sandy loam, 0 to 6 percent slopes	63	Sandy	73	IVe-12	80	-------	--	5
Sr	Stetter clay	64	Overflow	72	IVs-3	80	IIIs-1	89	4
Ss	Stetter clay, channeled	64	Overflow	72	VIw-2	81	-------	--	10
St	Stony steep land	64	Shallow Dense Clay	75	VIIs-6	82	-------	--	10
SuA	Swanboy clay, 0 to 3 percent slopes	65	Dense Clay	74	VIs-6	82	-------	--	10
Sv	Swanboy-Slickspots complex	66	----------	--	-------	--	-------	--	--
	Swanboy part	--	Dense Clay	74	VIs-6	82	-------	--	10
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
Te	Terrace escarpments	66	Thin Upland	74	VIIs-7	83	-------	--	10
TfD	Twilight fine sandy loam, 3 to 25 percent slopes	66	Sandy	73	VIe-7	81	-------	--	10
TgC	Twilight-Assinniboine fine sandy loams, 3 to 9 percent slopes	66	Sandy	73	-------	--	-------	--	--
	Twilight part	--	----------	--	VIe-7	81	-------	--	10
	Assinniboine part	--	----------	--	IVe-7	81	-------	--	5
ThD	Twilight-Blackhall fine sandy loams, 6 to 18 percent slopes	67	----------	--	VIe-7	81	-------	--	10
	Twilight part	--	Sandy	73	-------	--	-------	--	--
	Blackhall part	--	Shallow	74	-------	--	-------	--	--
ToB	Twotop clay, 0 to 9 percent slopes	67	Dense Clay	74	VIs-6	82	-------	--	10
VaA	Vale silt loam, 0 to 2 percent slopes	68	Silty	73	IIIc-1	77	I-2	87	3
WaB	Wasa-Slickspots complex, 0 to 6 percent slopes	69	----------	--	-------	--	-------	--	--
	Wasa part	--	Dense Clay	74	VIs-6	82	-------	--	10
	Slickspots	--	----------	--	VIIIs-3	83	-------	--	--
WhA	Whitelake fine sandy loam, 0 to 2 percent slopes	69	Sandy	73	IVe-12	80	IVes-4	90	5
WnB	Winler clay, 0 to 9 percent slopes	70	Dense Clay	74	VIs-6	82	-------	--	10
ZeB	Zeona loamy fine sand, 0 to 6 percent slopes	71	Sands	73	VIe-10	81	-------	--	7

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

BUTTE COUNTY, SOUTH DAKOTA

Scale 1:316,800
1 0 1 2 3 4 5 Miles

N

SOIL ASSOCIATIONS *

WELL DRAINED TO EXCESSIVELY DRAINED, NEARLY LEVEL TO STEEP SOILS FORMED IN MATERIAL DERIVED FROM CLAY SHALE ON UPLANDS

1 — Winler-Lismas association: Moderately deep and shallow, nearly level to moderately steep clayey soils over clay shale

2 — Pierre-Kyle association: Moderately deep and deep, nearly level to moderately steep clayey soils over clay shale

3 — Grummit-Shale land association: Shallow, gently sloping to steep clayey soils over acid clay shale, and Shale land

4 — Epsie association: Shallow, gently sloping to steep clayey soils over saline clay shale

WELL-DRAINED, GENTLY SLOPING TO MODERATELY STEEP SOILS FORMED IN MATERIAL DERIVED FROM SHALE AND LIMESTONE ON UPLANDS

5 — Midway-Penrose association: Shallow, gently sloping to moderately steep silty soils over shale and limestone

WELL DRAINED TO EXCESSIVELY DRAINED, NEARLY LEVEL TO VERY STEEP SOILS FORMED IN MATERIAL DERIVED FROM SILTSTONE, SANDSTONE, AND SHALE ON UPLANDS

6 — Cabbart-Absher association: Shallow, sloping to steep loamy soils over shale, siltstone, and sandstone, and deep, nearly level to sloping loamy soils that have a claypan

7 — Twilight-Absher association: Moderately deep, gently sloping to moderately steep loamy soils over sandstone, and deep, nearly level to sloping loamy soils that have a claypan

8 — Butche-Colby association: Shallow to deep, sloping to very steep loamy and silty soils over siltstone, sandstone, and shale

WELL-DRAINED, NEARLY LEVEL TO SLOPING SOILS FORMED IN ALLUVIUM ON TERRACES AND BOTTOM LAND

9 — Arvada-Stetter association: Deep, nearly level silty soils that have a claypan and are on terraces, and deep, nearly level clayey soils on bottom land

10 — Lohmiller-Glenberg-Haverson association: Deep, nearly level silty and loamy soils on bottom land and low terraces

11 — Caputa-Satanta association: Deep, nearly level to sloping loamy soils on high terraces

12 — Sorum association: Deep, nearly level to gently sloping loamy soils that have a claypan and are on terraces

* The texture is that of the surface layer of the major soils.

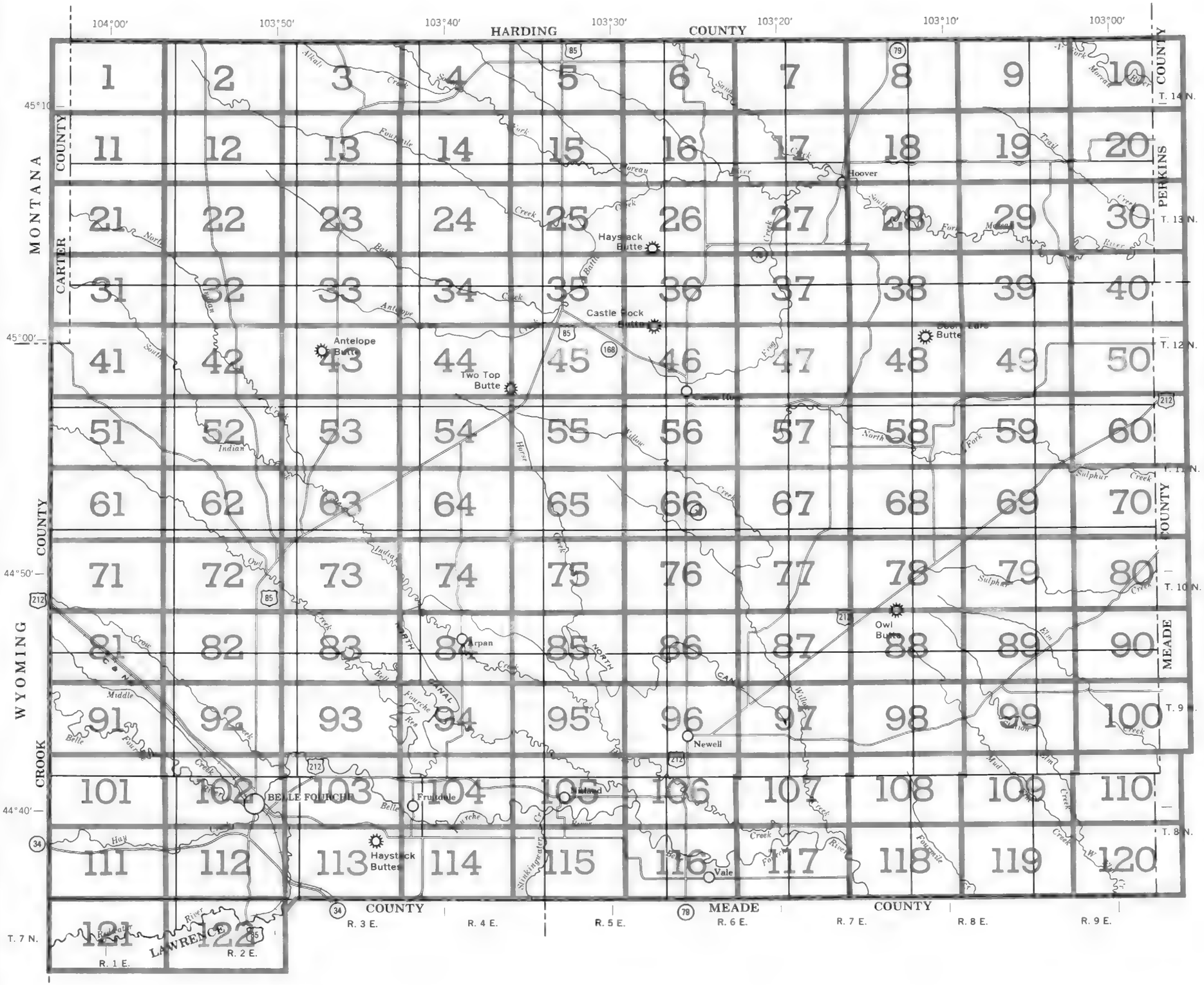
Compiled 1974

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS
BUTTE COUNTY, SOUTH DAKOTA

Scale 1:316,800
1 0 1 2 3 4 5 Miles

N



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those for nearly level soils, but some are for land types that have a considerable range of slope.

SYMBOL	NAME
AbA	Absher-Oburn complex, 0 to 3 percent slopes
AbB	Absher-Oburn complex, 3 to 9 percent slopes
AeB	Absher-Slickspots complex, 0 to 9 percent slopes
AfB	Alice fine sandy loam, 2 to 6 percent slopes
AfC	Alice fine sandy loam, 6 to 9 percent slopes
AlA	Altvan loam, 0 to 2 percent slopes
AlB	Altvan loam, 2 to 6 percent slopes
AnA	Archin-Slickspots complex, 0 to 3 percent slopes
ArA	Arvada silt loam, 0 to 3 percent slopes
AsA	Arvada-Slickspots complex, 0 to 3 percent slopes
AtA	Assinniboine fine sandy loam, 0 to 3 percent slopes
BaA	Baca silty clay loam, 0 to 2 percent slopes
BaB	Baca silty clay loam, 2 to 6 percent slopes
Bd	Badland
Be	Barnum silt loam
Bh	Barnum silt loam, channeled
BlA	Belfield-Oburn silt loams, 0 to 3 percent slopes
BlB	Belfield-Oburn silt loams, 3 to 6 percent slopes
BmA	Bidman loam, 0 to 3 percent slopes
BmB	Bidman loam, 3 to 6 percent slopes
BrB	Bidman-Redig complex, 2 to 9 percent slopes
BsB	Boneek silt loam, 2 to 6 percent slopes
BsC	Boneek silt loam, 6 to 9 percent slopes
BtB	Broadhurst clay, 0 to 6 percent slopes
BuD	Butche-Boneek complex, 6 to 25 percent slopes
BvF	Butche-Rock outcrop complex, 25 to 50 percent slopes
CaF	Cabbart loam, 25 to 40 percent slopes
CbD	Cabbart-Lismas complex, 6 to 18 percent slopes
CcF	Cabbart-Rock outcrop complex, 25 to 50 percent slopes
CgD	Cabbart-Scroggin loams, 6 to 25 percent slopes
ClF	Canyon-Colby complex, 25 to 50 percent slopes
CmA	Caputa loam, 0 to 2 percent slopes
CmB	Caputa loam, 2 to 6 percent slopes
CmC	Caputa loam, 6 to 9 percent slopes
CnA	Chinook fine sandy loam, 0 to 3 percent slopes
CoD	Colby-Canyon silt loams, 6 to 25 percent slopes
DsA	Dix sandy loam, 0 to 3 percent slopes
EpD	Epsie clay, 3 to 25 percent slopes
EsE	Epsie-Shale land complex, 9 to 45 percent slopes
GgA	Glenberg fine sandy loam, 0 to 2 percent slopes
GgB	Glenberg fine sandy loam, 2 to 6 percent slopes
Gh	Glenberg and Haverson soils
GnC	Graner clay, 3 to 25 percent slopes
GrE	Grummit clay, 3 to 25 percent slopes

SYMBOL	NAME
Ha	Hanly loamy fine sand
HeA	Haverson loam, 0 to 2 percent slopes
HeB	Haverson loam, 2 to 6 percent slopes
HlB	Hisle loam, 0 to 9 percent slopes
HsB	Hisle-Slickspots complex, 0 to 9 percent slopes
KeA	Keith silt loam, 0 to 2 percent slopes
KeB	Keith silt loam, 2 to 6 percent slopes
KeC	Keith silt loam, 6 to 9 percent slopes
KlA	Kyle clay, 0 to 2 percent slopes
KlB	Kyle clay, 2 to 6 percent slopes
KlC	Kyle clay, 6 to 9 percent slopes
Kt	Kyle clay, terrace
KuB	Kyle-Pierre clays, 0 to 6 percent slopes
LaF	Lakoa-Colby association, 9 to 50 percent slopes
LcE	Lismas clay, 3 to 25 percent slopes
LeD	Lismas-Pierre clays, 3 to 18 percent slopes
Lm	Loamy alluvial land
LnA	Lohmiller silty clay loam, 0 to 2 percent slopes
LnB	Lohmiller silty clay loam, 2 to 6 percent slopes
Lo	Lohmiller silty clay loam, saline
Ls	Lohmiller silty clay loam, acid variant
MaA	Manter fine sandy loam, 0 to 2 percent slopes
MaB	Manter fine sandy loam, 2 to 6 percent slopes
McA	Manvel silty clay loam, 0 to 2 percent slopes
McB	Manvel silty clay loam, 2 to 6 percent slopes
Mh	Marsh
MlA	Mawer fine sandy loam, 0 to 2 percent slopes
MlB	Mawer fine sandy loam, 2 to 6 percent slopes
Mn	McKenzie clay
MoE	Midway silty clay loam, 6 to 25 percent slopes
MrD	Midway-Razor silty clay loams, 3 to 15 percent slopes
Ms	Minatare-Whitelake complex
Mt	Mine pits and dumps
MuB	Minnequa silty clay loam, 2 to 6 percent slopes
MuC	Minnequa silty clay loam, 6 to 9 percent slopes
NeB	Nevee silt loam, 2 to 6 percent slopes
NsD	Nevee-Spearfish silt loams, 6 to 25 percent slopes
ObA	Oburn loam, 0 to 3 percent slopes
PaA	Parshall fine sandy loam, 0 to 3 percent slopes
PeE	Penrose silty clay loam, 6 to 25 percent slopes

SYMBOL	NAME
PmD	Penrose-Minnequa silty clay loams, 3 to 15 percent slopes
PrA	Pierre clay, 0 to 2 percent slopes
PrB	Pierre clay, 2 to 6 percent slopes
PrD	Pierre clay, 6 to 21 percent slopes
RaB	Ralph loam, 3 to 6 percent slopes
RcA	Razor silty clay loam, 0 to 2 percent slopes
RcB	Razor silty clay loam, 2 to 6 percent slopes
RcC	Razor silty clay loam, 6 to 9 percent slopes
RdE	Redig clay loam, 9 to 25 percent slopes
Rh	Riverwash
RsF	Rock outcrop-Spearfish complex, 25 to 50 percent slopes
Sa	Saline-Alkali land
Sb	Saline alluvial land
ScA	Satanta loam, 0 to 2 percent slopes
ScB	Satanta loam, 2 to 6 percent slopes
ScC	Satanta loam, 6 to 9 percent slopes
SdA	Savo silty clay loam, 0 to 2 percent slopes
SdB	Savo silty clay loam, 2 to 6 percent slopes
SeE	Schamber loam, 6 to 25 percent slopes
Sg	Shale land
ShF	Shale land-Grummit complex, 15 to 45 percent slopes
SkB	Slickspots-Demar complex, 0 to 6 percent slopes
SlB	Slicksport-Wasa complex, 0 to 6 percent slopes
SmE	Snomo-Shale land complex, 3 to 25 percent slopes
SnB	Sorum fine sandy loam, 0 to 6 percent slopes
Sr	Stetter clay
Ss	Stetter clay, channeled
St	Stony steep land
SuA	Swanboy clay, 0 to 3 percent slopes
Sv	Swanboy-Slickspots complex
Te	Terrace escarpments
TfD	Twilight fine sandy loam, 3 to 25 percent slopes
TgC	Twilight-Assinniboine fine sandy loams, 3 to 9 percent slopes
ThD	Twilight-Blackhall fine sandy loams, 6 to 18 percent slopes
ToB	Twotop clay, 0 to 9 percent slopes
VaA	Vale silt loam, 0 to 2 percent slopes
WaB	Wasa-Slickspots complex, 0 to 6 percent slopes
WhA	Whitelake fine sandy loam, 0 to 2 percent slopes
WnB	Winler clay, 0 to 9 percent slopes
ZeB	Zeona loamy fine sand, 0 to 6 percent slopes

BUTTE COUNTY, SOUTH DAKOTA — SHEET NUMBER 1

BUTTE COUNTY, SOUTH DAKOTA NO 1

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

960 000 FEET

R. 1 E.

HARDING COUNTY

525 000 FEET

T. 14 N.

CARTER COUNTY

MONTANA

(Joins sheet 2)

(Joins sheet 11)

980 000 FEET

N

2 Miles

10000 Feet

5000

0

1000

2000

3000

4000

5000

Scale 1:24000

(10)

N

HARDING COUNTY

R. 9 E.

1 240 000 FEET

515 000 FEET

T. 14 N.

PERKINS COUNTY

1 220 000 FEET

(Joins sheet 9)

(Joins sheet 20)

North Fork Moreau River

2 Miles

10000 Feet

Scale 1:24000

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100

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0

¼ 0

½ 1000 2000

¾ 3000 4000

1 5000 0

(Joins sheet 90)

(Joins sheet 99)

(Joins sheet 110)

R. 9 E.

T. 9 N.

1 240 000 FEET

345 000 FEET

335 000 FEET

1 210 000 FEET

MEADE COUNTY

Land division corners are approximately positioned on this map.

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BUTTE COUNTY, SOUTH DAKOTA NO. 100

BUTTE COUNTY, SOUTH DAKOTA NO. 101

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Land division corners are approximately positioned on this map.

(Joins sheet 91)
(Joins sheet 102)
(Joins sheet 111)

950 000 FEET
340 000 FEET
970 000 FEET
330 000 FEET
R. 1 E.
T. 9 N.
T. 8 N.

WYOMING
CROOK COUNTY

Scale 1:24000
2 Miles
10000 Feet

N

R. 1 E. | R. 2 E.

(Joins sheet 92)

1 000 000 FEET

340 000 FEET

T. 8 N. | T. 9 N.

(Joins sheet 101)

330 000 FEET

(Joins sheet 103)

(Joins sheet 112)

980 000 FEET

BELLE FOURCHE
(county seat)

RIVERVIEW CEMETERY

SEWAGE LAGOON

Middle Creek

Redwater River

Scale 1:24000

2 Miles 1 0 10000 Feet

5000 0 5000

¼ 0 1000

½ 0 2000

¾ 0 3000 4000

1 5000

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Land division corners are approximate and based on the South Dakota coordinate system, north zone.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximately positioned on this map

BUTTE COUNTY, SOUTH DAKOTA NO. 103

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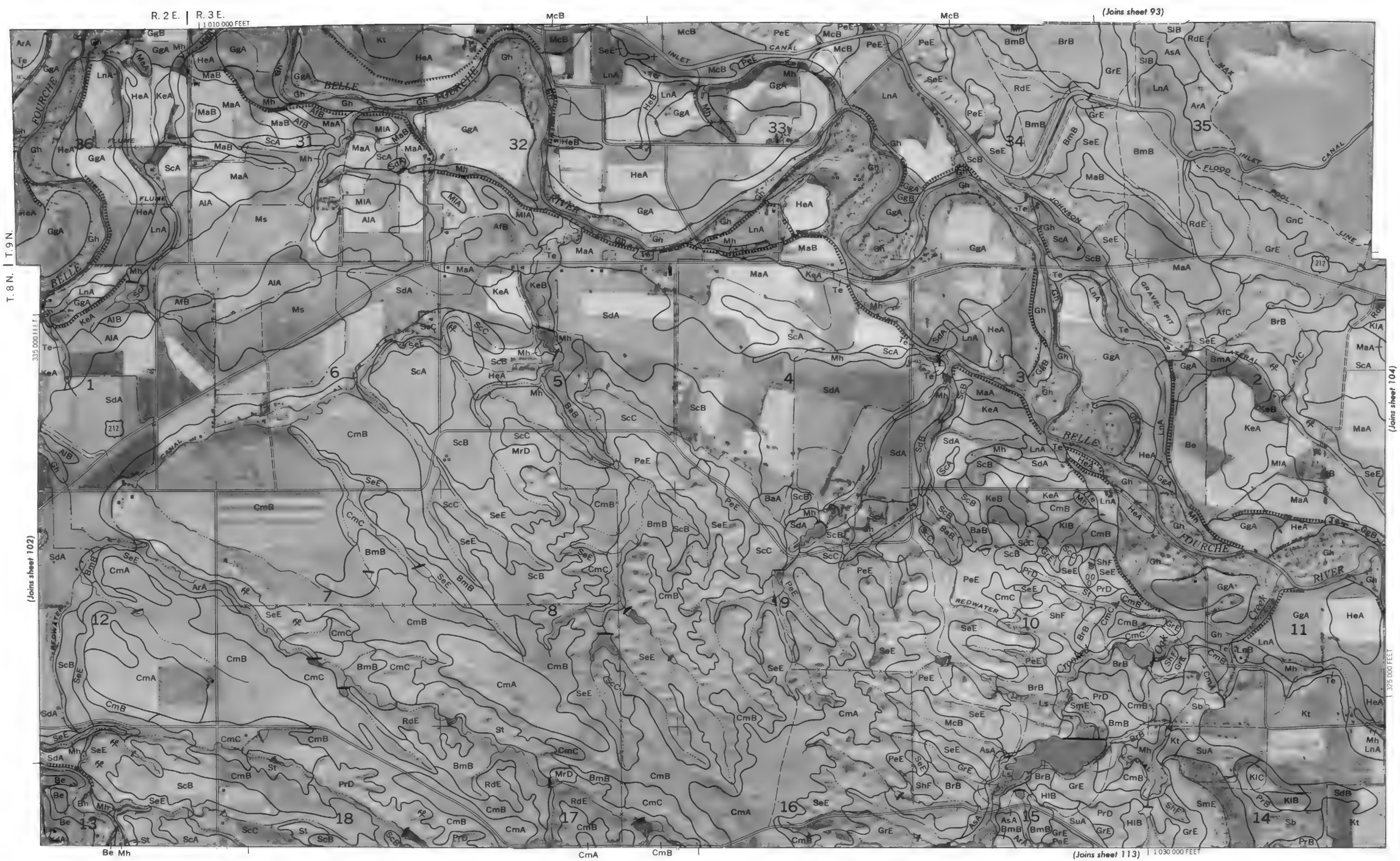
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



104

N

R. 3 E. | R. 4 E. (Joins sheet 94)

1 060 000 FEET

BELLE FOURCHE RESERVOIR

INLET CANAL

MAXIMUM FLOOD POOL LINE

(Joins sheet 103)

(Joins sheet 105)

T. 8 N. | T. 9 N.

325 000 FEET

335 000 FEET

(Joins sheet 114)

1 040 000 FEET

2 Miles

10000 Feet

Scale 1:24000

0 1000 2000 3000 4000 5000 Feet

0 ¼ ½ ¾ 1 Kilometer

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

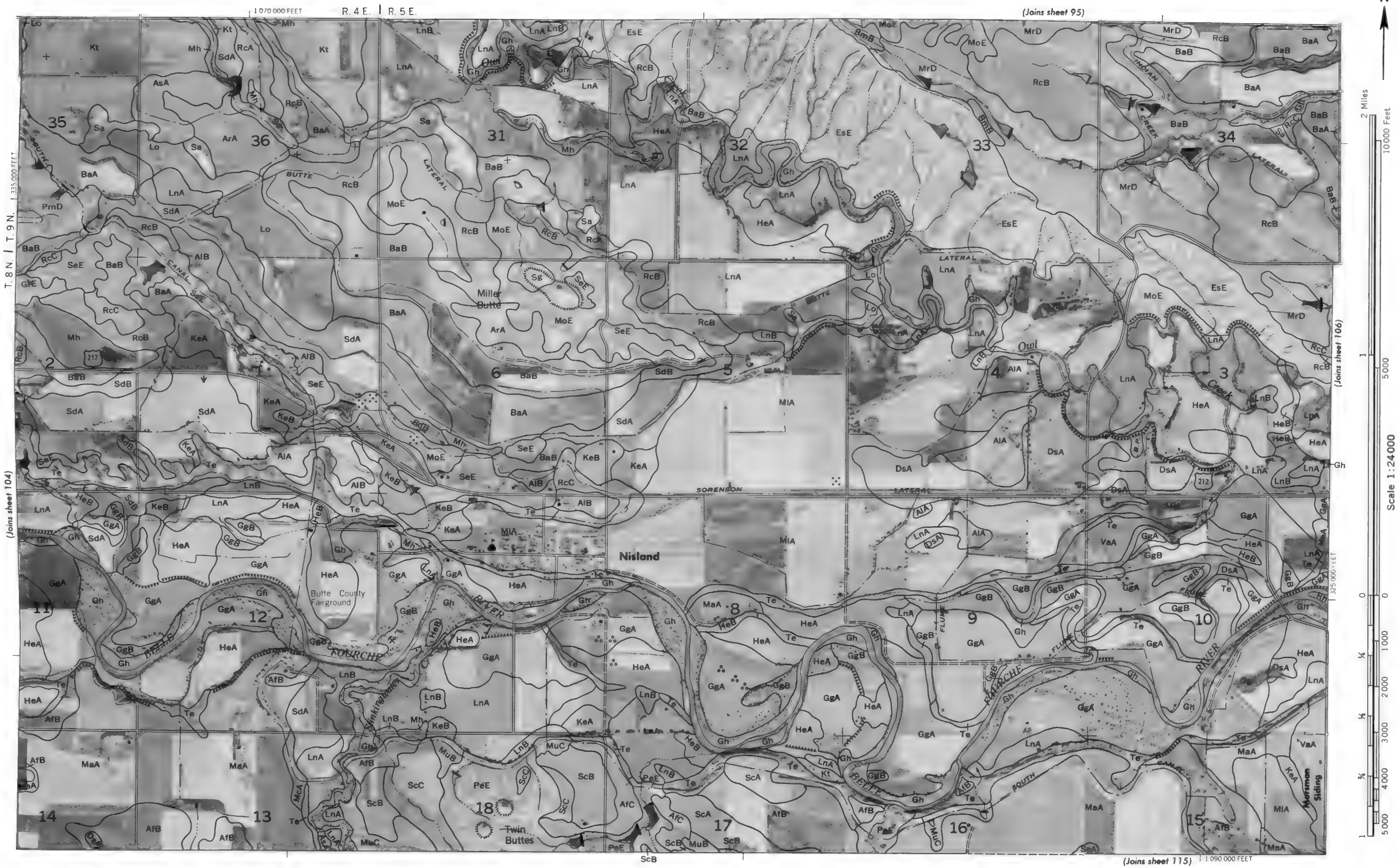
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 105

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

Land division corners are approximately positioned on this map



106

N

R. 5 E. | R. 6 E.

T. 8 N. | T. 9 N.

(Joins sheet 96)

(Joins sheet 105)

(Joins sheet 107)

(Joins sheet 116)

1 120 000 FEET

330 000 FEET

1 100 000 FEET

320 000 FEET

2 Miles 10000 Feet

Scale 1:24000

1 5000

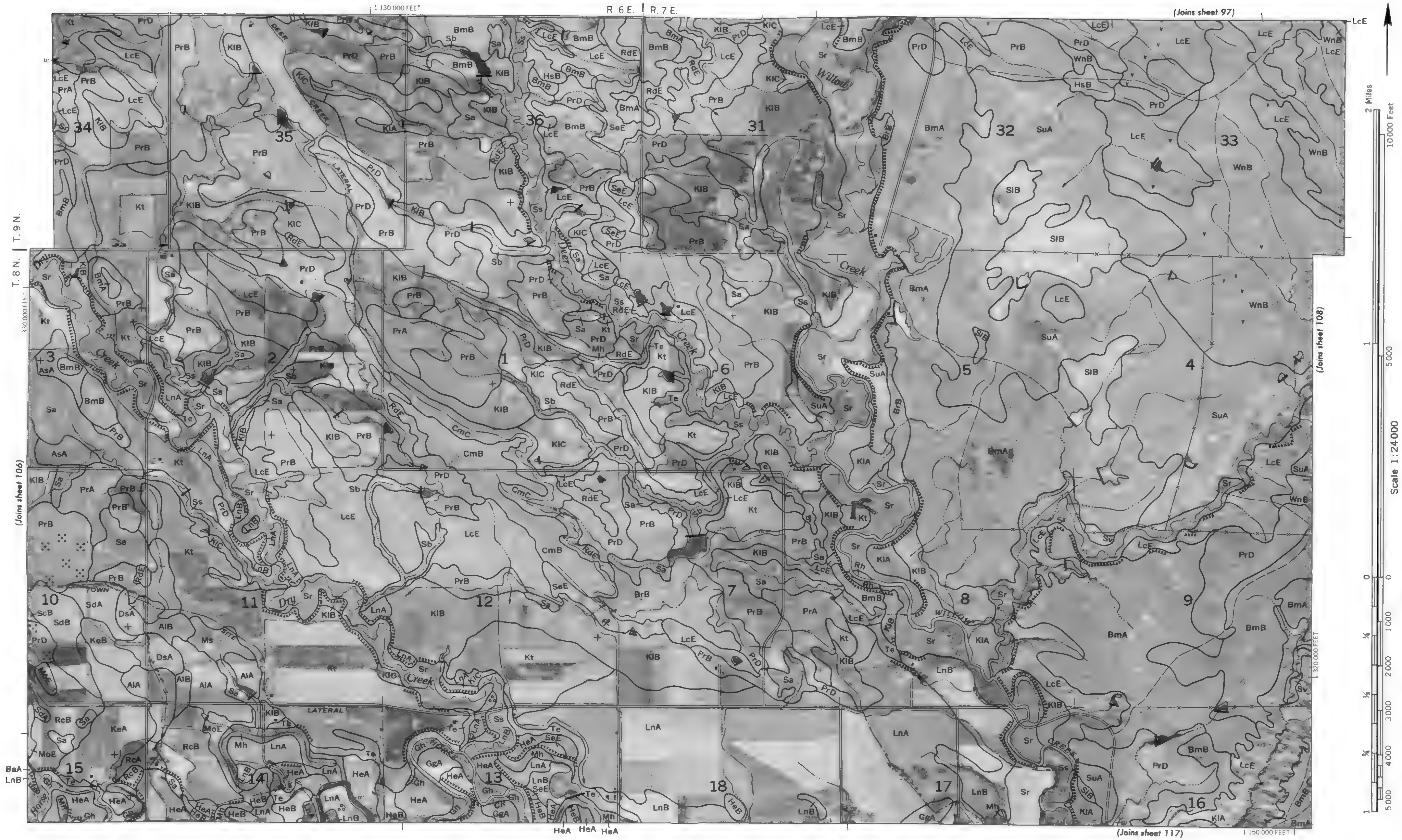
1/2 0 1/2

1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.



BUTTE COUNTY, SOUTH DAKOTA NO. 107

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

108

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

¼ 2000

¾ 3000

½ 4000

5000

1 180 000 FEET

330 000 FEET

320 000 FEET

1 160 000 FEET

R. 7 E. | R. 8 E.

T. 8 N. | T. 9 N.

(Joins sheet 98)

(Joins sheet 107)

(Joins sheet 109)

(Joins sheet 118)

Land division corners are approximately positioned on this map.

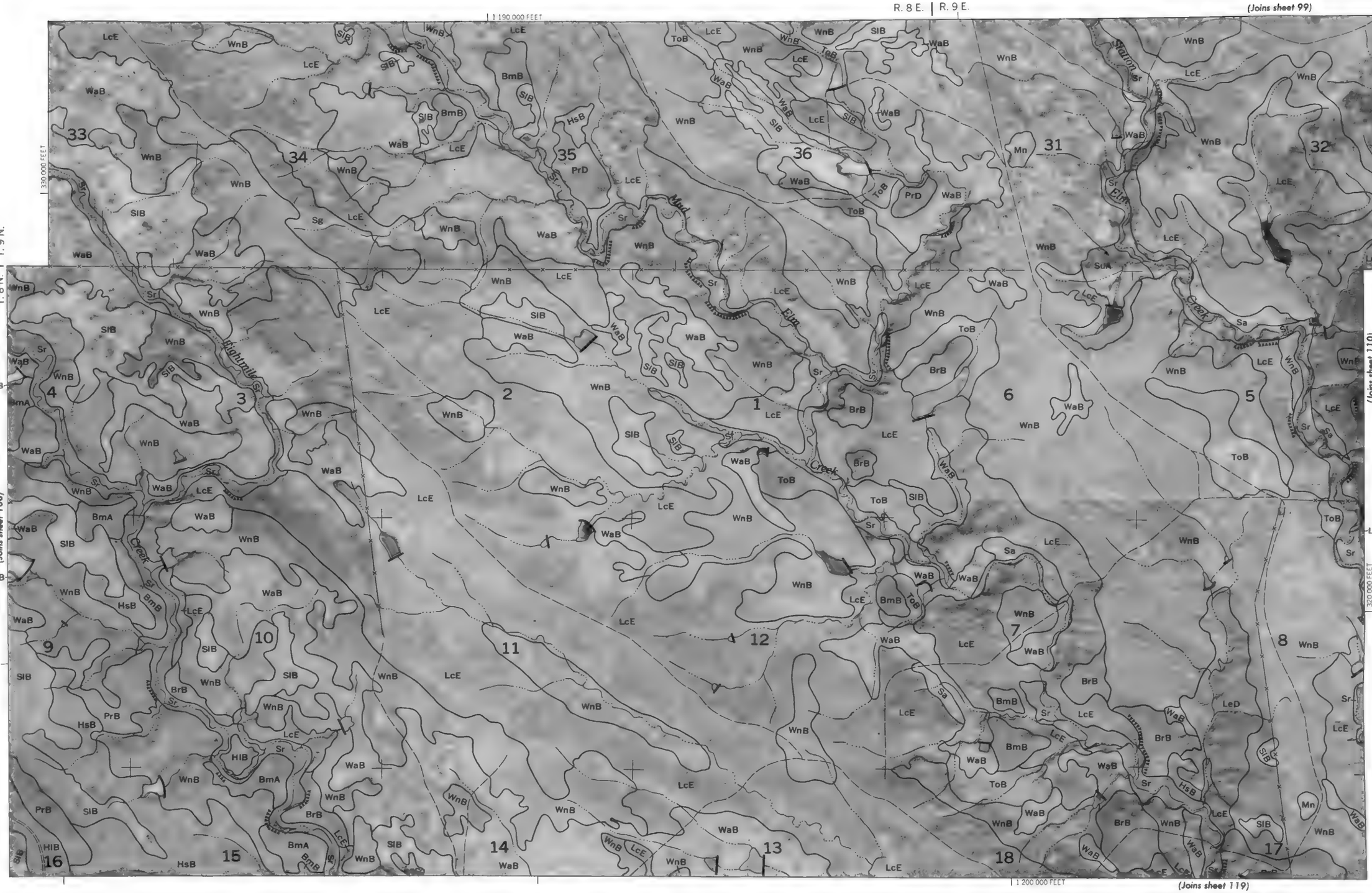
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 108

BUTTE COUNTY, SOUTH DAKOTA NO. 109

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



109

N

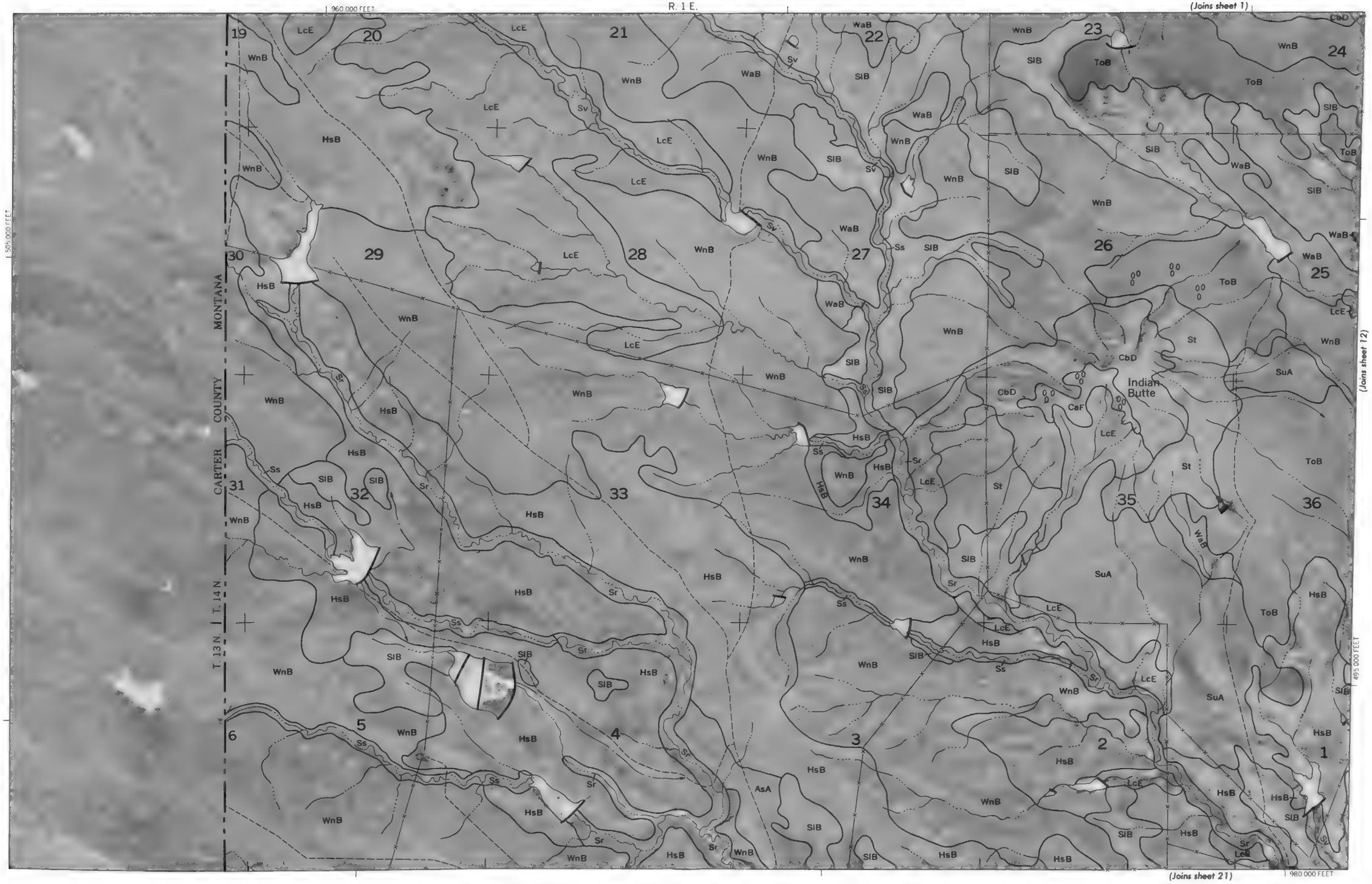
2 Miles
10000 Feet
1
5000

Scale 1:24000

0 0
¼ 1000
½ 2000
¾ 3000
1 4000
5000

BUTTE COUNTY, SOUTH DAKOTA NO. 11

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



11

N

2 Miles
10000 Feet

Scale 1:24000

1 5000 0
¼ 4000 0
½ 3000 1000
¾ 2000
1 5000

(110)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

(Joins sheet 100)

R. 9 E.

1 230 000 FEET

325 000 FEET

T. 8 N.

T. 9 N.

(Joins sheet 109)

(Joins sheet 120)

1 210 000 FEET

MEADE COUNTY

BUTTE COUNTY, SOUTH DAKOTA NO. 110

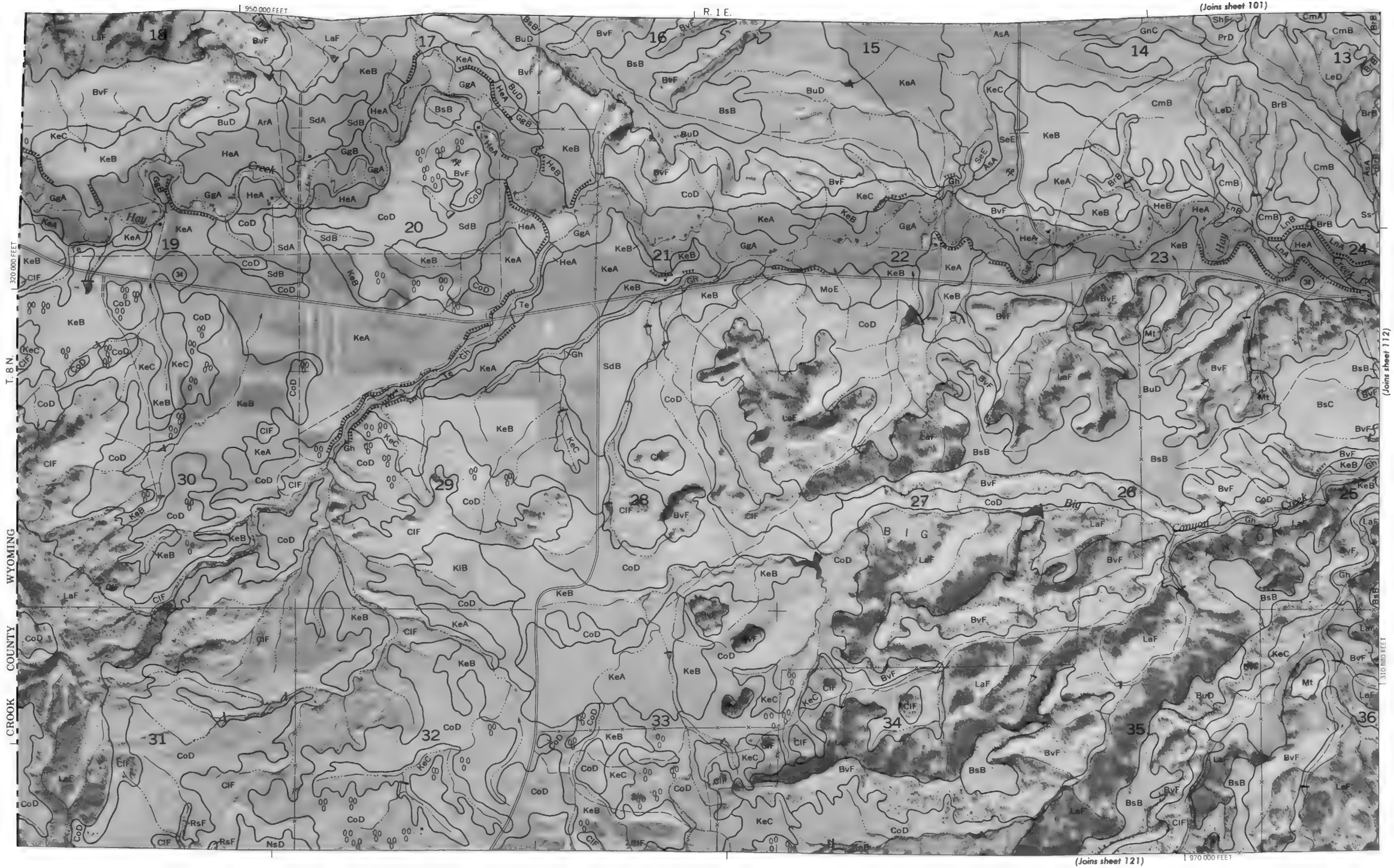
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 111

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

BUTTE COUNTY, SOUTH DAKOTA NO. 113

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

R. 2 E. | R. 3 E.

1 010 000 FEET

(Joins sheet 103)

320,000 FEET

T. 8 N.

1 310 000 FEET

1 030 000 FEET

(Joins sheet 112)

(122)

LAWRENCE COUNTY

(Joins sheet 114)

N

2 Miles

10000 Feet

Scale 1:24000

1 0 5000

¼ 0 1000

½ 0 2000

¾ 0 3000

1 0 4000

¼ 0 5000

(114)

N

(Joins sheet 104) R. 3 E. | R. 4 E.

1 060 000 FEET

T. 8 N.

1 315 000 FEET

(Joins sheet 113)

305 000 FEET

1 040 000 FEET

LAWRENCE COUNTY

(Joins sheet 115)

Scale 1:24000

2 Miles 1 0

10000 Feet 5000 0

1 1/2 1 1/2 1 1/2 1

5000 4000 3000 2000 1000 0

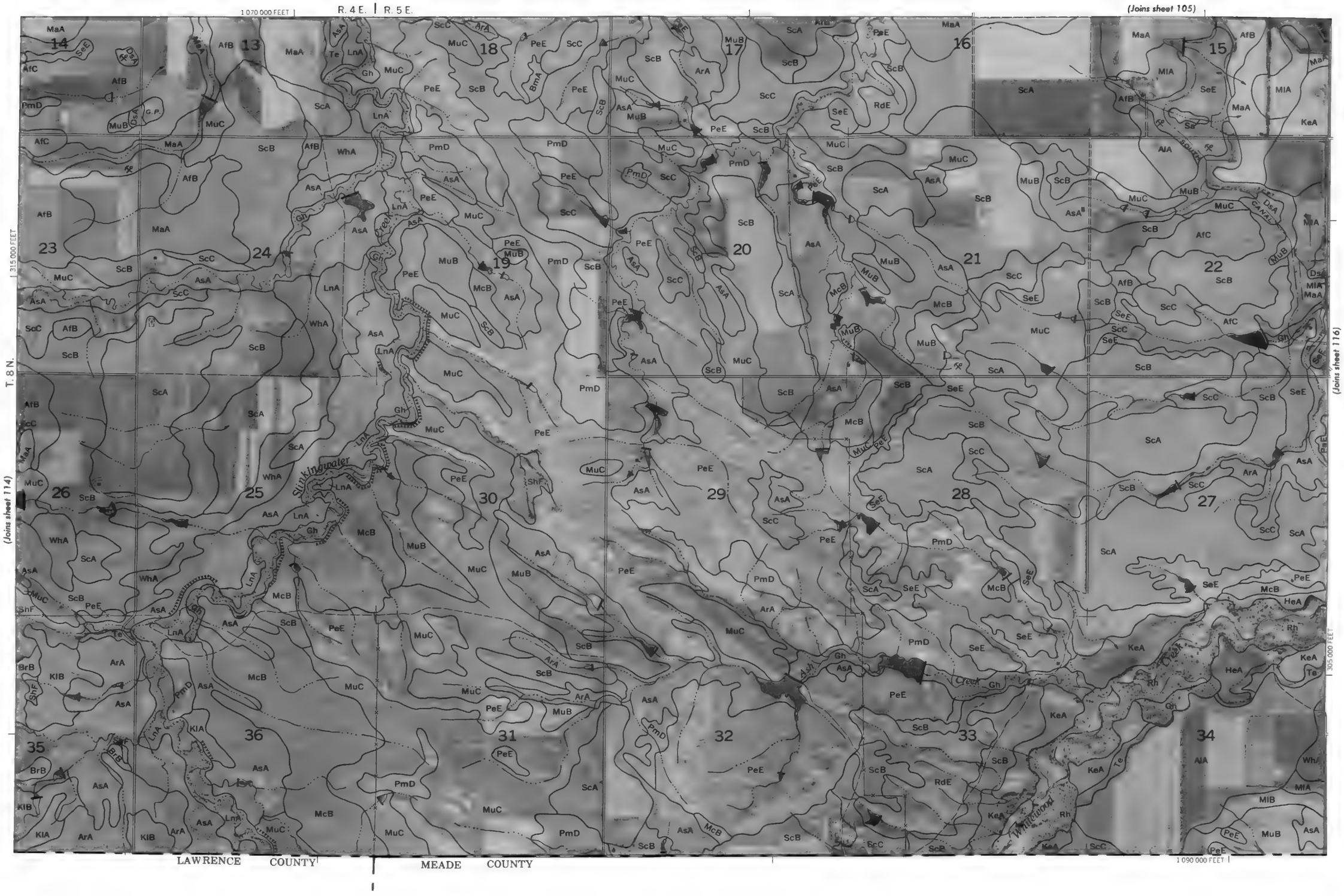
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 115

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 116

BUTTE COUNTY, SOUTH DAKOTA NO. 117

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

R. 7 E. | R. 8 E.

1 170 000 FEET

310 000 FEET

T. 8 N.

300 000 FEET

1 150 000 FEET

(Joins sheet 108)

(Joins sheet 117)

(Joins sheet 119)

MEADE COUNTY

Scale 1:24000

2 Miles 10000 Feet

1 5000

1 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 119

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

R. 8 E. | R. 9 E.

(Joins sheet 109)

(Joins sheet 118)

(Joins sheet 120)

T. 8 N.

1 180 000 FEET

1 310 000 FEET

1 300 000 FEET

1 200 000 FEET

MEADE COUNTY

Eightmile Creek

Fourmile Creek

Mud Elm Creek

Scale 1:24000

2 Miles 1 0

10000 Feet 5000 0

N

R. 1 E. | R. 2 E. (Joins sheet 2)

1 010 000 FEET

505 000 FEET

495 000 FEET

990 000 FEET

(Joins sheet 11)

(Joins sheet 22)

(Joins sheet 13)

T. 13 N. | T. 14 N.

2 Miles

10000 Feet

Scale 1:24000

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

Scale 1:24000

2 Miles 0 1 2 3 4

10000 Feet 0 1000 2000 3000 4000 5000

1 5000

(Joins sheet 110)

(Joins sheet 119)

R. 9 E.

T. 8 N.

1 230 000 FEET

1 210 000 FEET

300 000 FEET

310 000 FEET

MEADE COUNTY

MEADE COUNTY

16 15 14 13

21 22 23 24

28 27 26 25

33 34 35 36

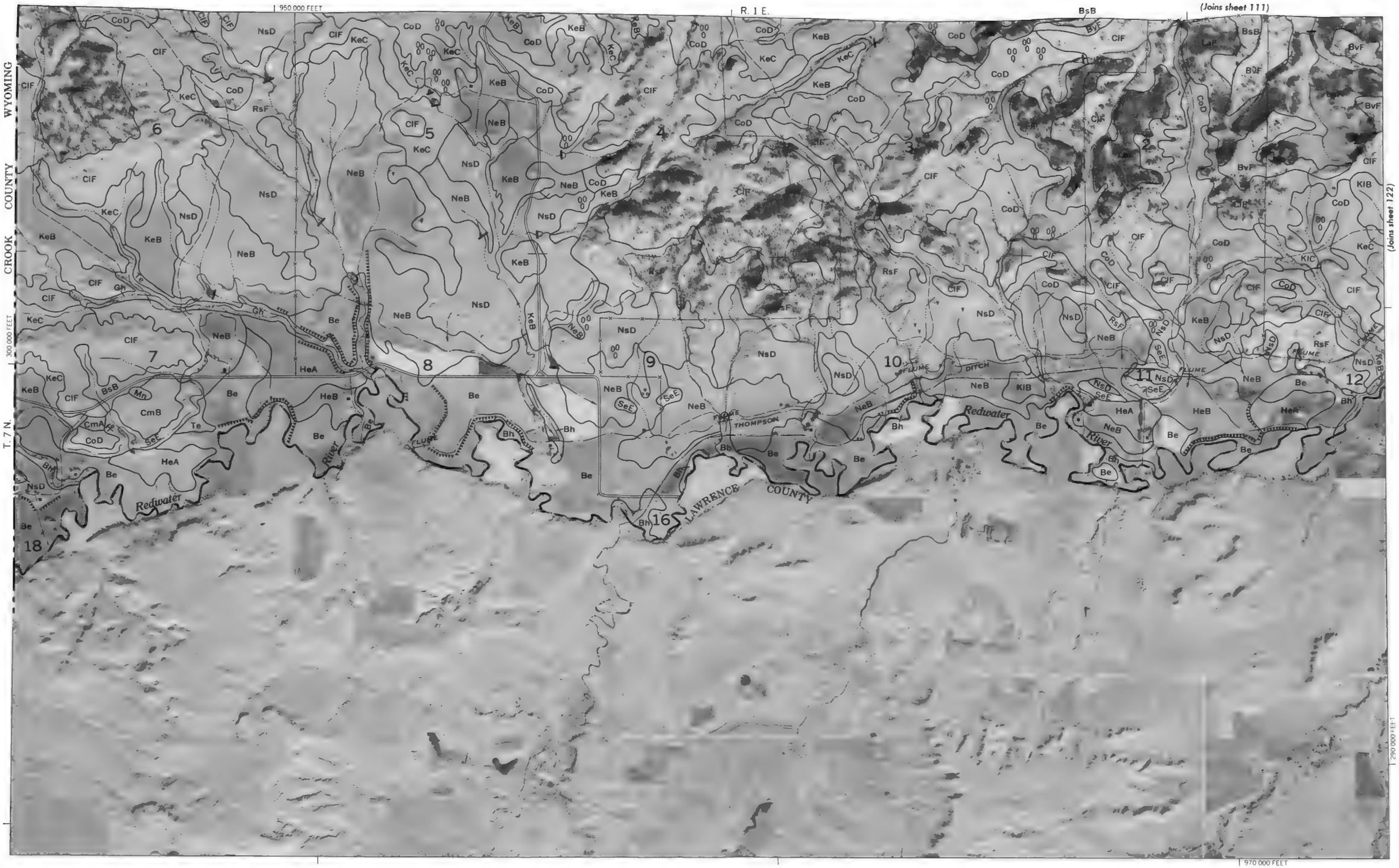
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 121

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



N

2 Miles
10000 Feet
1
5000
Scale 1:24000
0
0
¼
1000
½
2000
¾
3000
1
4000
1¼
5000

N

Scale 1:24000

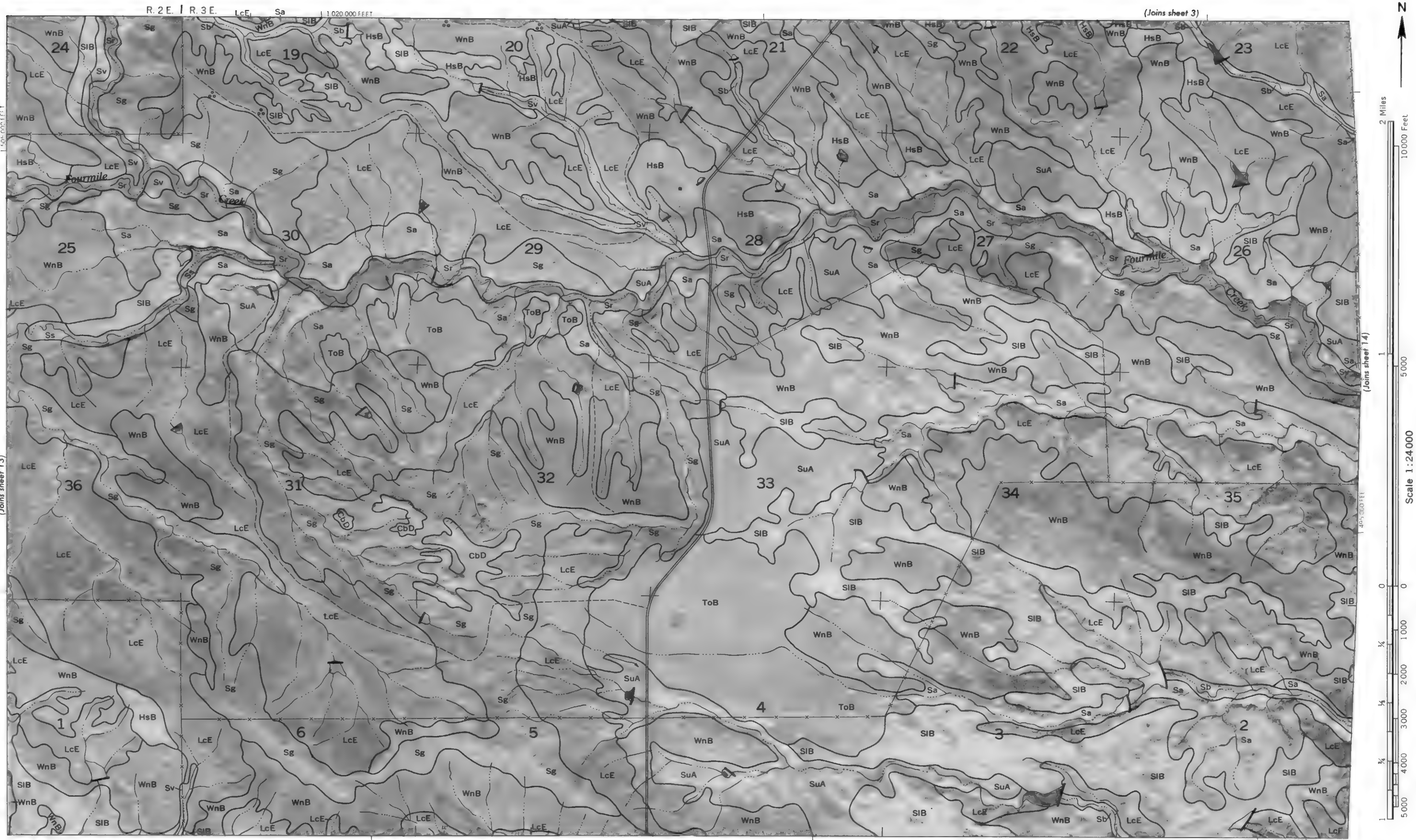
1 Inch = 2 Miles
1 Centimeter = 10000 Feet

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 122

BUTTE COUNTY, SOUTH DAKOTA NO. 13

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map



14

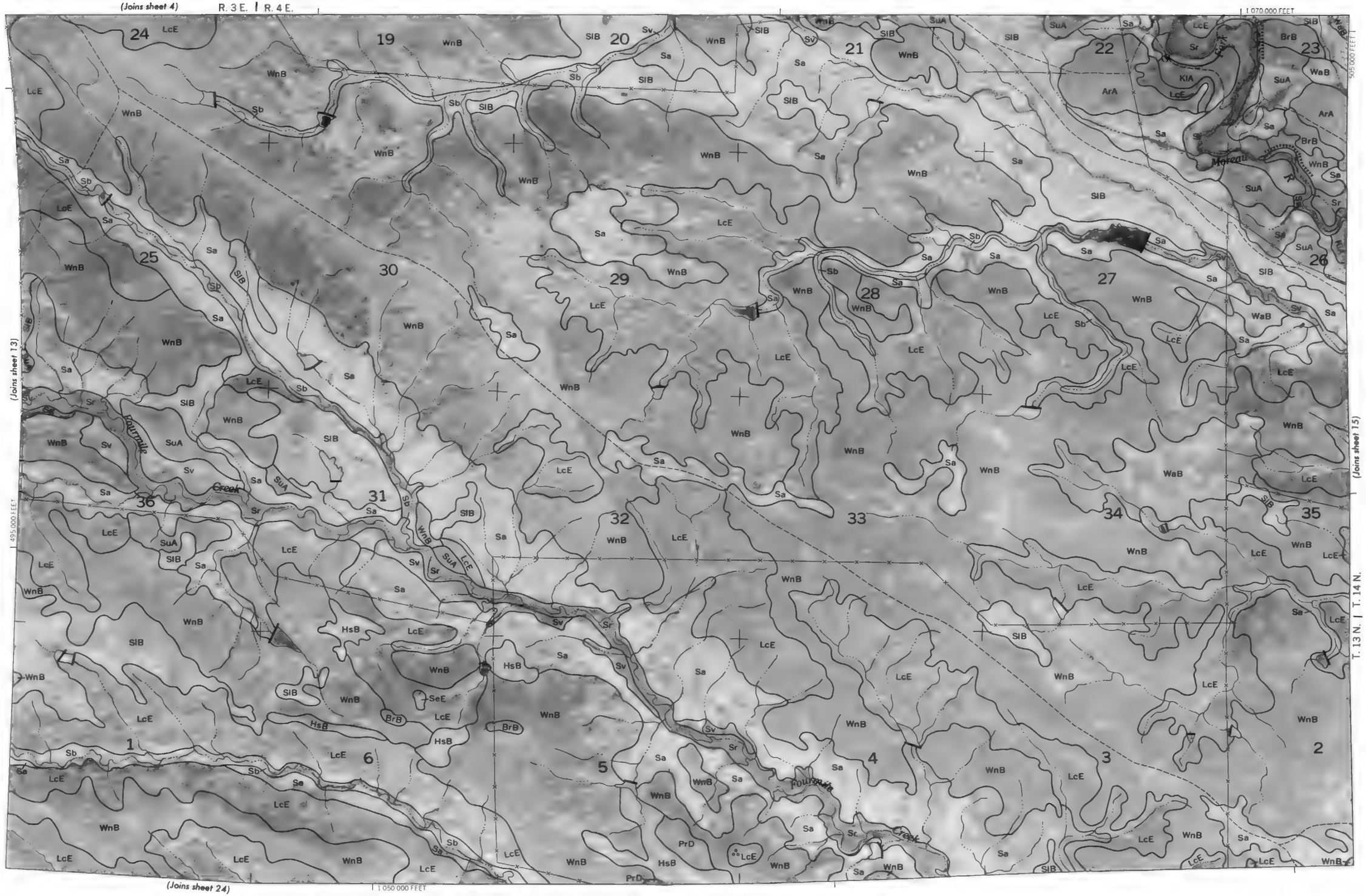
N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 ¼ 1000 ½ 2000 ¾ 3000 1 4000 5000



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 14

BUTTE COUNTY, SOUTH DAKOTA NO. 15

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
Land division corners are approximately positioned on this map

R. 4 E. | R. 5 E.

1 080 000 FEET

500 000 FEET

T. 13 N. | T. 14 N.

(Joins sheet 5)

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 25)

N

2 Miles 10000 Feet 1 5000 0

Scale 1:24000

1 430 000 FEET

0 1000 2000 3000 4000 5000

N

R. 5 E. | R. 6 E.

T. 14 N. | T. 13 N.

(Joins sheet 6)

(Joins sheet 15)

(Joins sheet 17)

(Joins sheet 26)

1 130 000 FEET

500 000 FEET

490 000 FEET

1 110 000 FEET

2 Miles

10000 Feet

5000

Scale 1:24000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

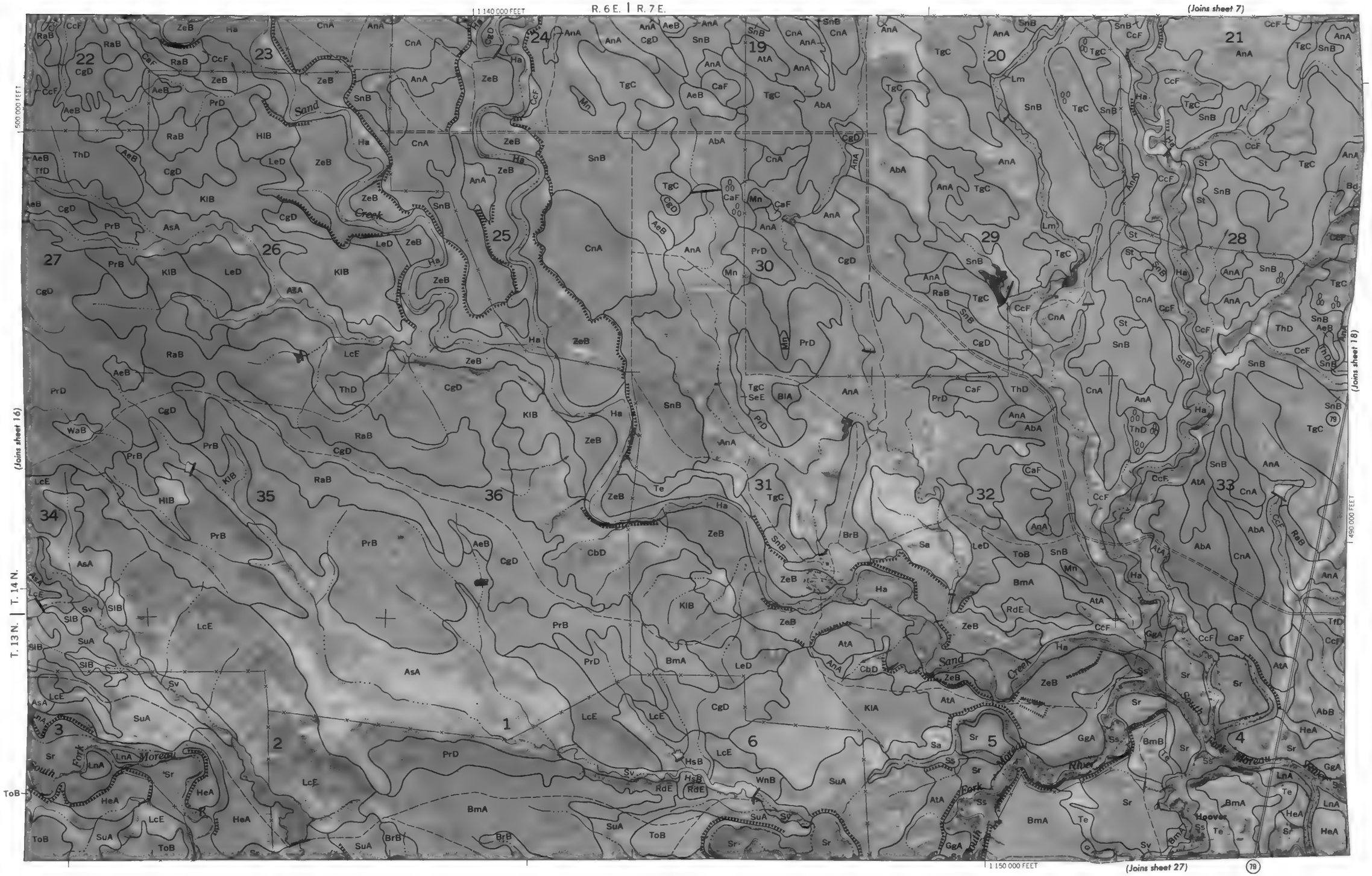
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system north zone.

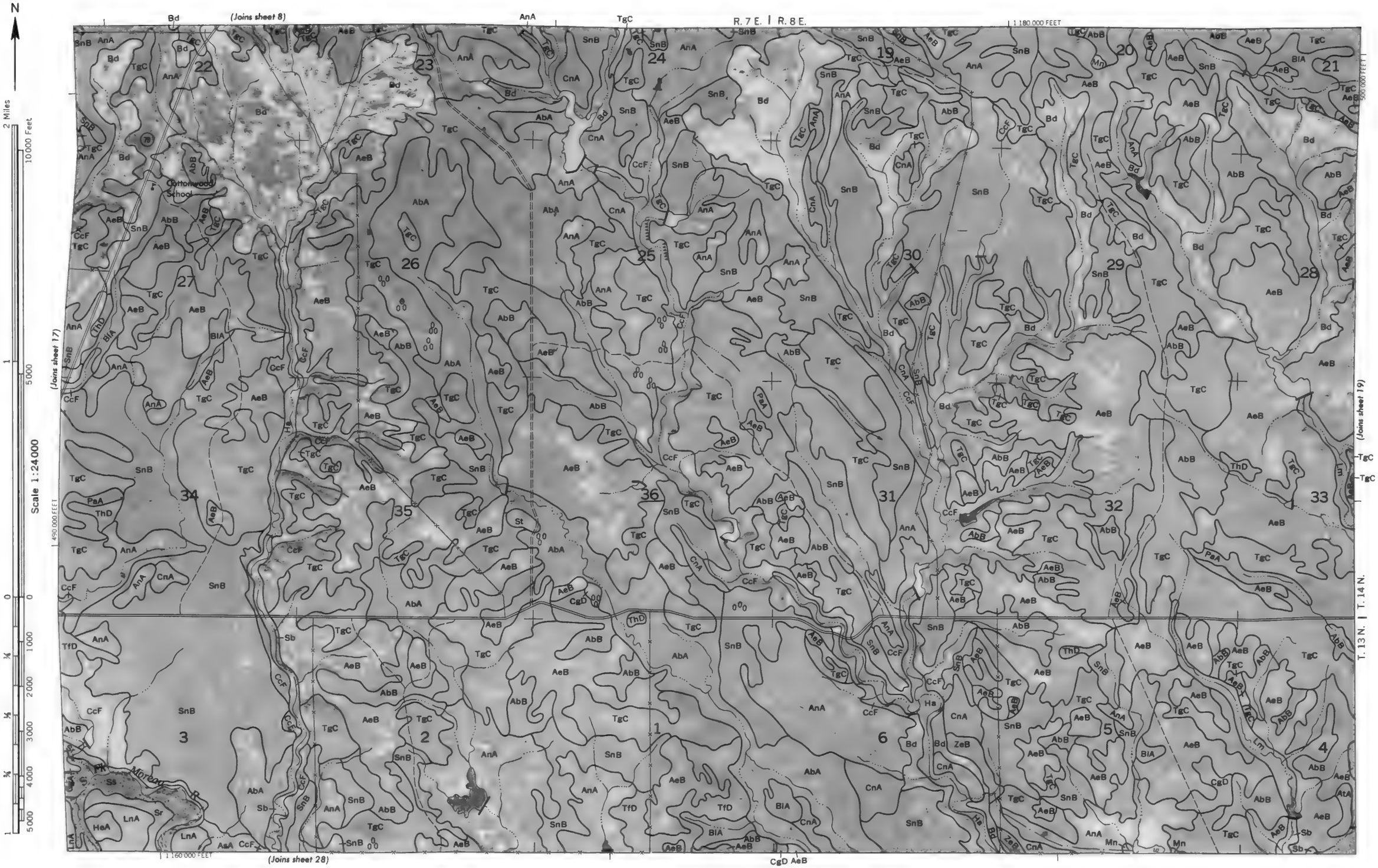
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station

BUTTE COUNTY, SOUTH DAKOTA NO. 16

BUTTE COUNTY, SOUTH DAKOTA NO. 17

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.





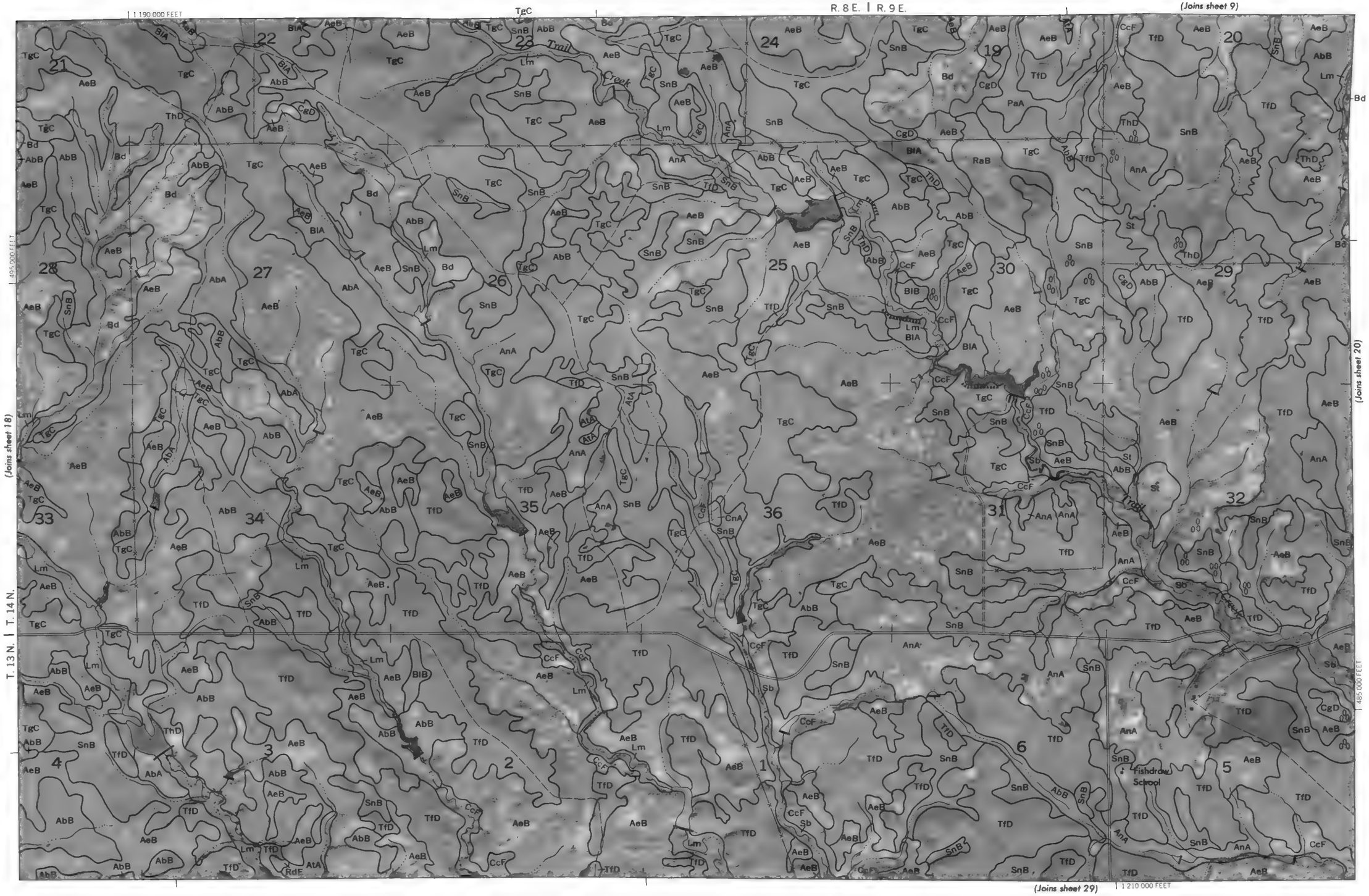
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 19

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



(2)

N

R. 1 E. | R. 2 E.

HARDING COUNTY

1 010 000 FEET

525 000 FEET

T. 14 N.

(Joins sheet 1)

(Joins sheet 3)

515 000 FEET

990 000 FEET

(Joins sheet 12)

2 Miles

10000 Feet

Scale 1:24000

1 0 ½ 0 1 000 ½ 2000 ¾ 3000 ¾ 4000 1 5000

Fourmile Creek

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO 2

(20)

N

2 Miles 10000 Feet

1 5000 0 1000 2000 3000 4000 5000

Scale 1:24000

(Joins sheet 10)

R. 9 E.

1 240 000 FEET

1 495 000 FEET

(Joins sheet 19)

1 485 000 FEET

1 220 000 FEET

(Joins sheet 30)

T. 13 N. | T. 14 N.

PERKINS COUNTY

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 20

BUTTE COUNTY, SOUTH DAKOTA NO. 21

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

960 000 FEET

R. 1 E.

(Joins sheet 11)

485 000 FEET

T. 13 N.

MONTANA

CARTER COUNTY

(Joins sheet 22)

(Joins sheet 31)

980 000 FEET

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

North Indian Creek

N

R. 1 E. | R. 2 E.

(Joins sheet 12)

1 010 000 FEET

485 000 FEET

T. 13 N.

(Joins sheet 21)

(Joins sheet 23)

475 000 FEET

990 000 FEET

(Joins sheet 32)

SuA

Scale 1:24000

2 Miles 10000 Feet

1 5000 0

0 1000 2000 3000 4000 5000

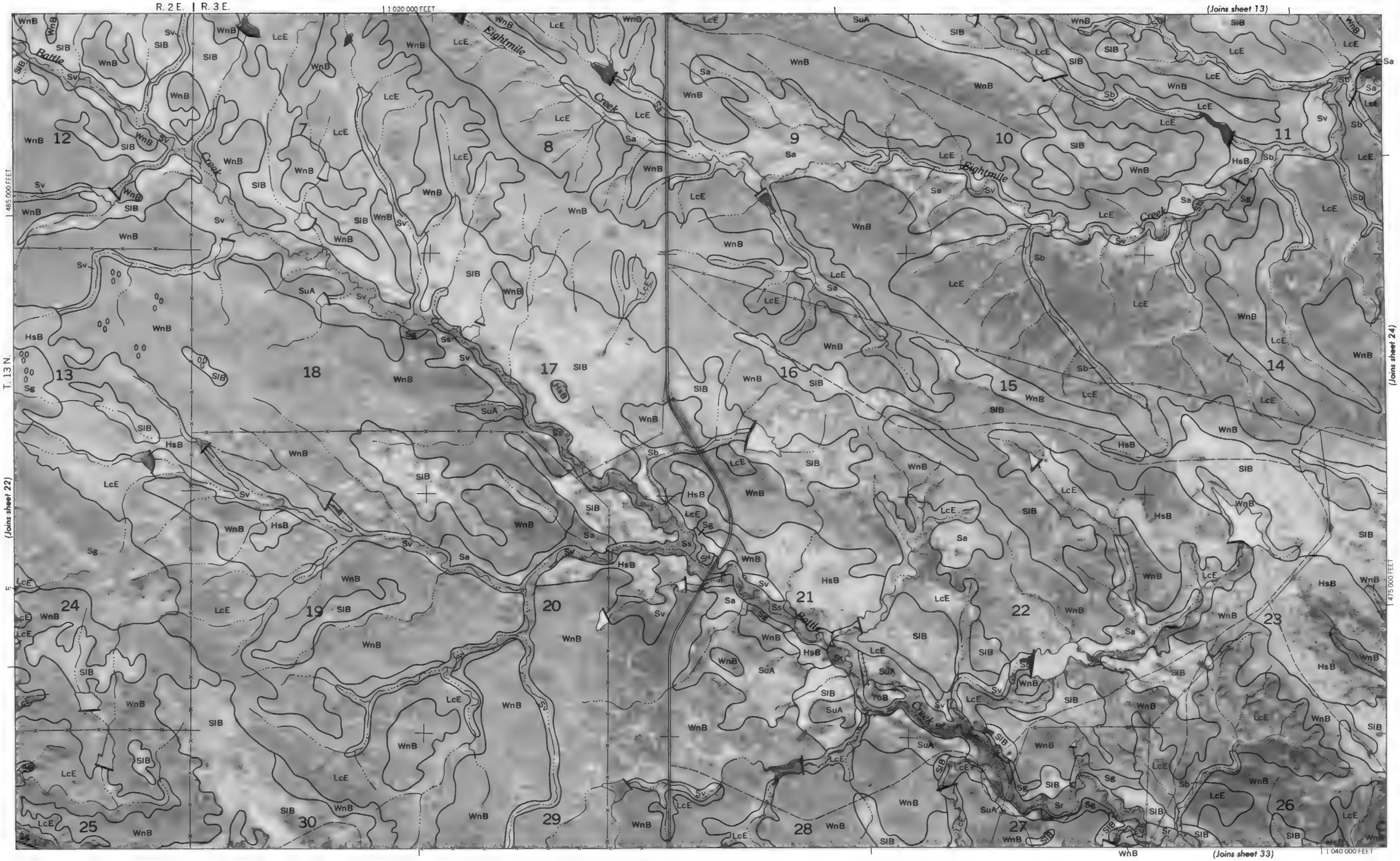
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.

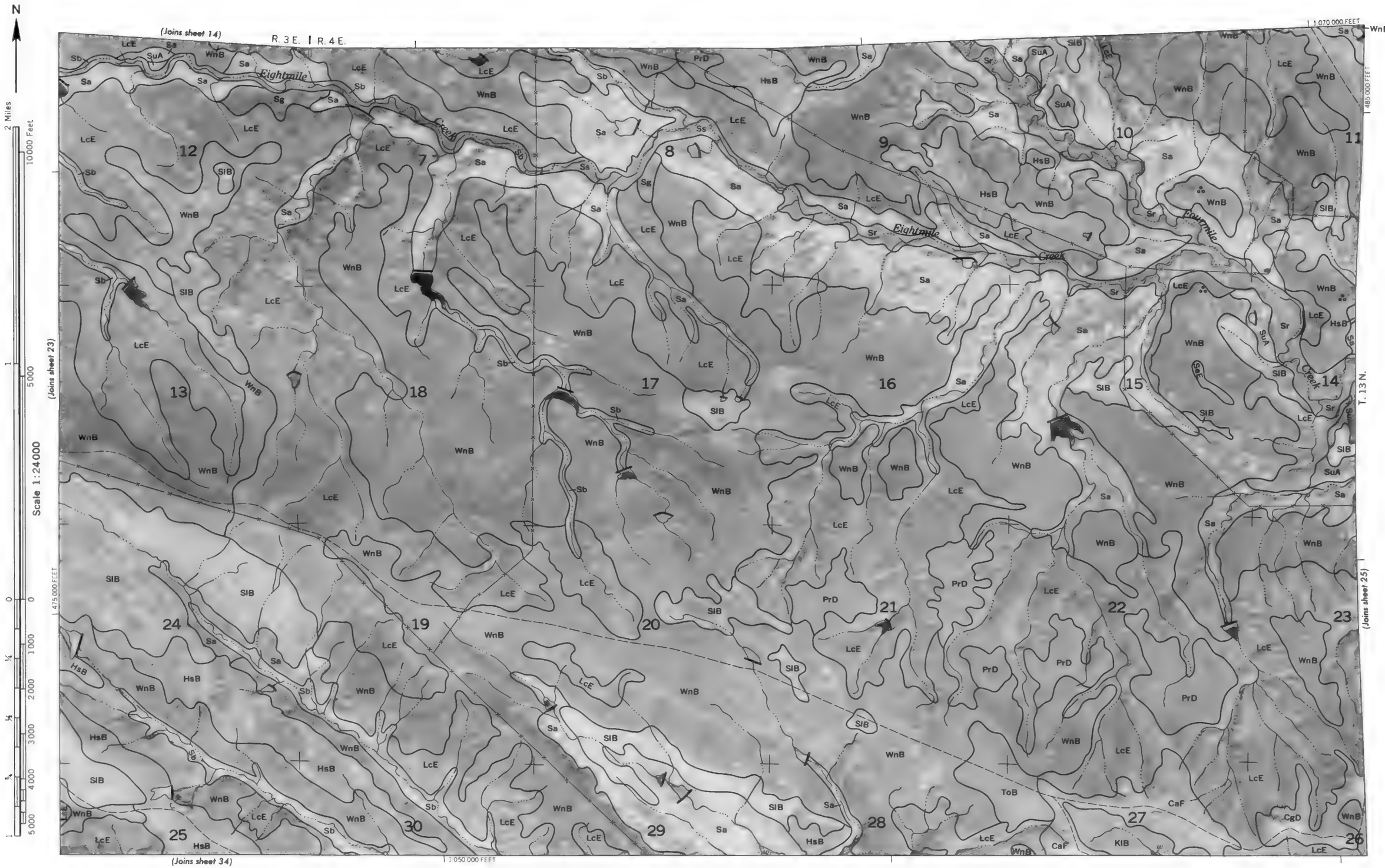
Photobase from 1971 aerial photography Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 23

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
Land division corners are approximately positioned on this map.





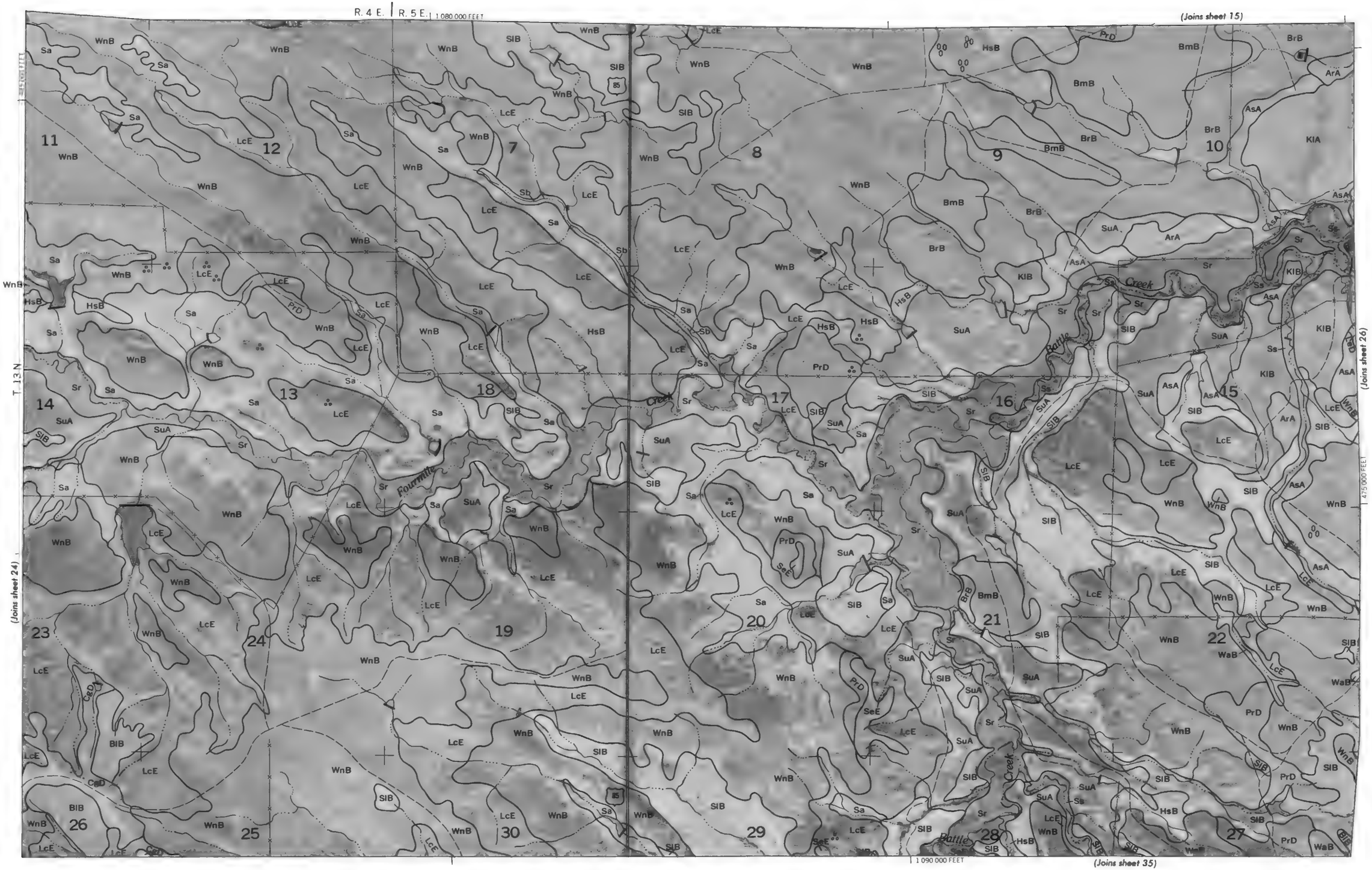
Land division corners are approximately positioned on this map.

Photobases from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 25

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



N

2 Miles 1

10000 Feet 5000

Scale 1:24000

1 0 1000 2000 3000 4000 5000

N

R. 5 E. | R. 6 E.

T. 13 N.

(Joins sheet 16)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 36)

Scale 1:24000

2 Miles 10000 Feet

1 5000

0 0

1/4 1000

1/2 2000

3/4 3000

1 4000

1 5000

1 100 000 FEET

480 000 FEET

Haystack Butte

Land division corners are approximately positioned on this map

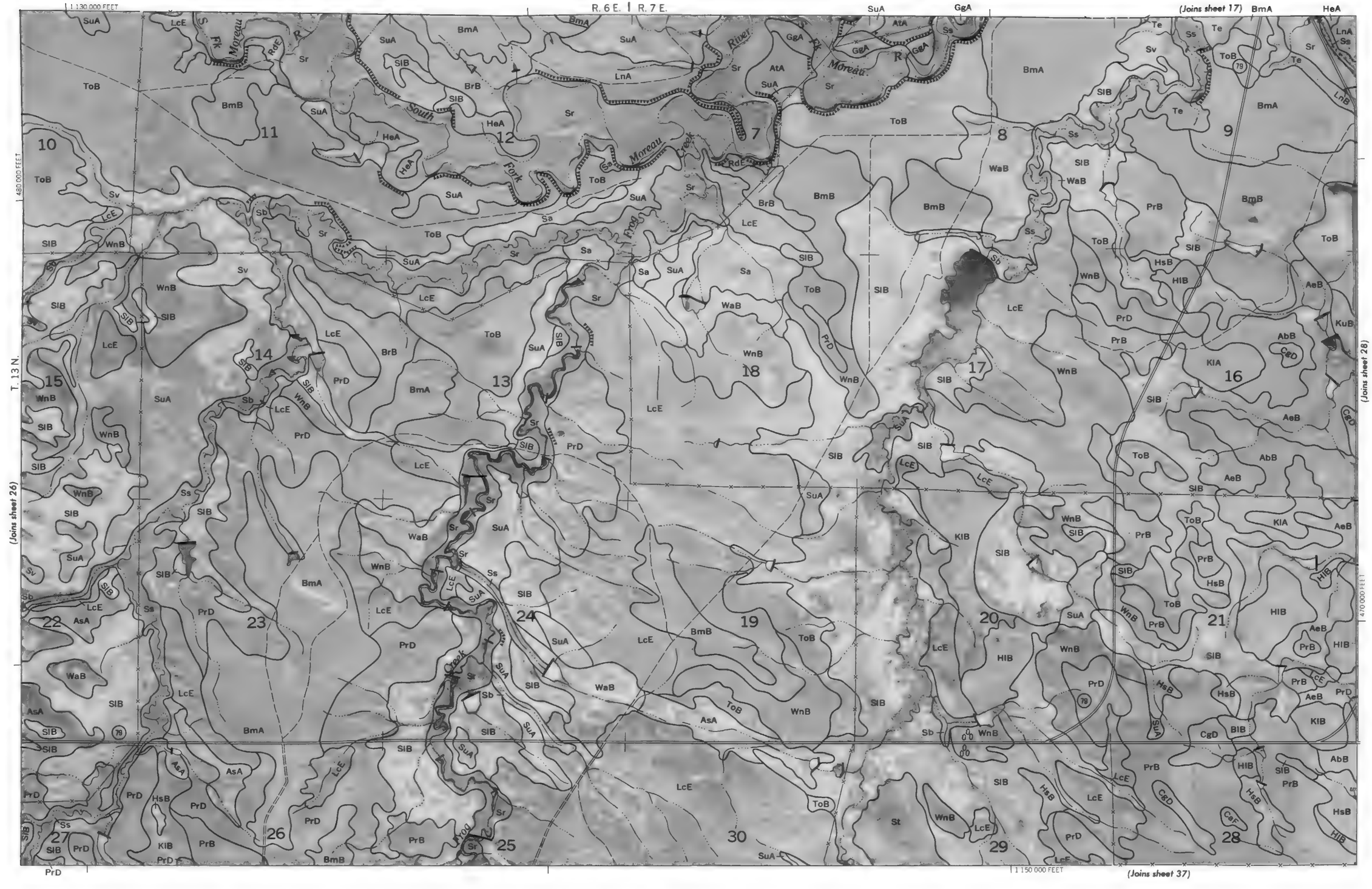
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station

BUTTE COUNTY, SOUTH DAKOTA — SHEET NO. 26

BUTTE COUNTY, SOUTH DAKOTA NO. 27

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



N

R. 7 E. | R. 8 E.

1 180 000 FEET

(Joins sheet 18)

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 38)

470 000 FEET

T. 13 N.

South Fork Moreau River

Warren Creek

2 Miles

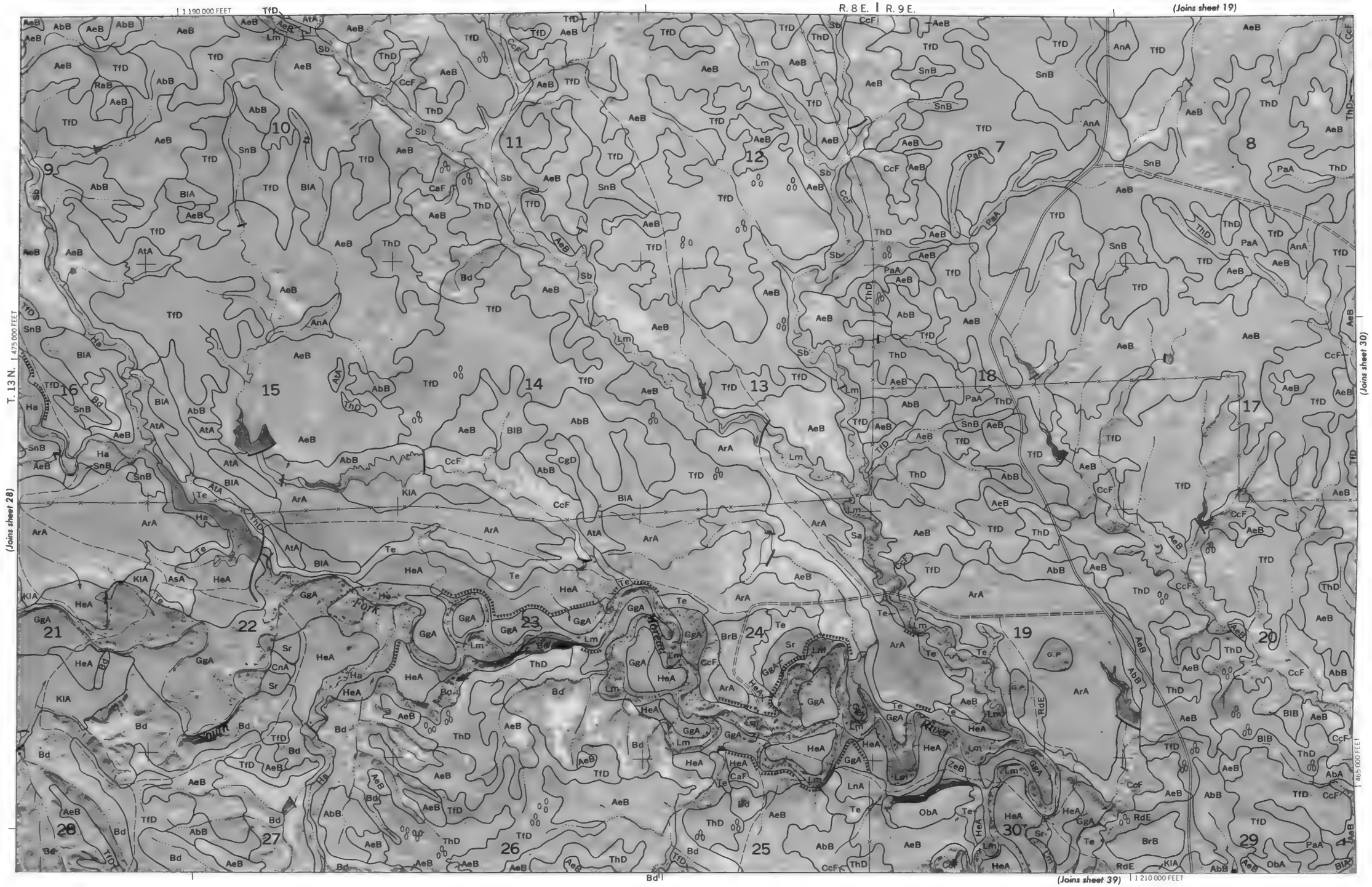
10000 Feet

Scale 1:24000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.



BUTTE COUNTY, SOUTH DAKOTA NO. 29

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

2 Miles
10000 Feet
Scale 1:24000

BUTTE COUNTY, SOUTH DAKOTA NO 3

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
Land division corners are approximately positioned on this map.

HARDING COUNTY

R. 2 E. | R. 3 E.

1 020 000 FEET

525 000 FEET

T. 14 N.

Alkali Creek

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 13)

1 040 000 FEET

N

2 Miles 1 0 1

10000 Feet 5000 0

Scale 1:24000

1 0 ¼ ½ ¾ 1

1000 2000 3000 4000 5000

N

Scale 1:24000

2 Miles 1 0

10000 Feet 5000 0

(Joins sheet 20)

R. 9 E.

1 240 000 FEET

1 475 000 FEET

T. 13 N.

PERKINS COUNTY

(Joins sheet 29)

(Joins sheet 40)

1 220 000 FEET

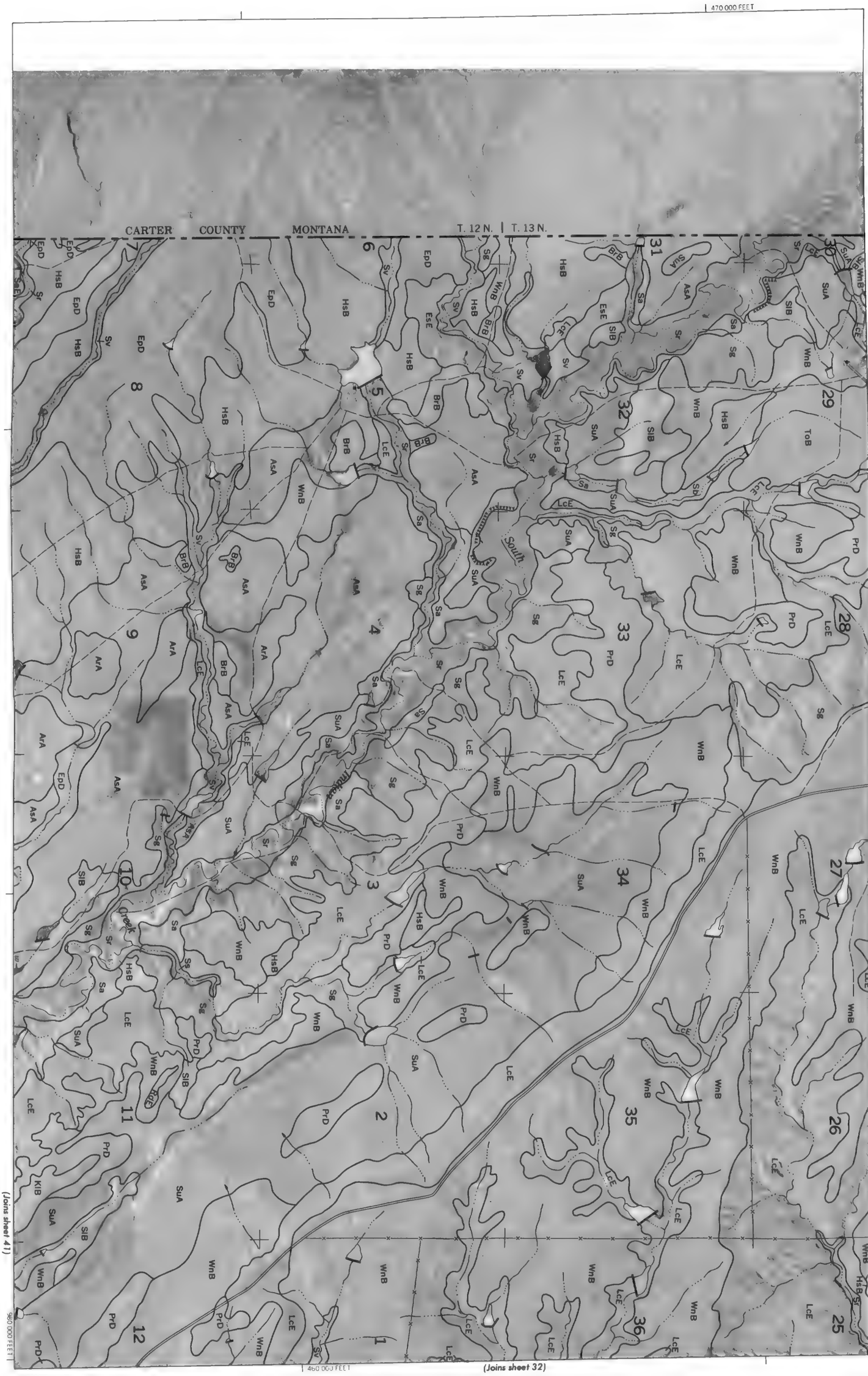
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 31

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



1 ¾ ½ ¼ 0 1 2 Miles

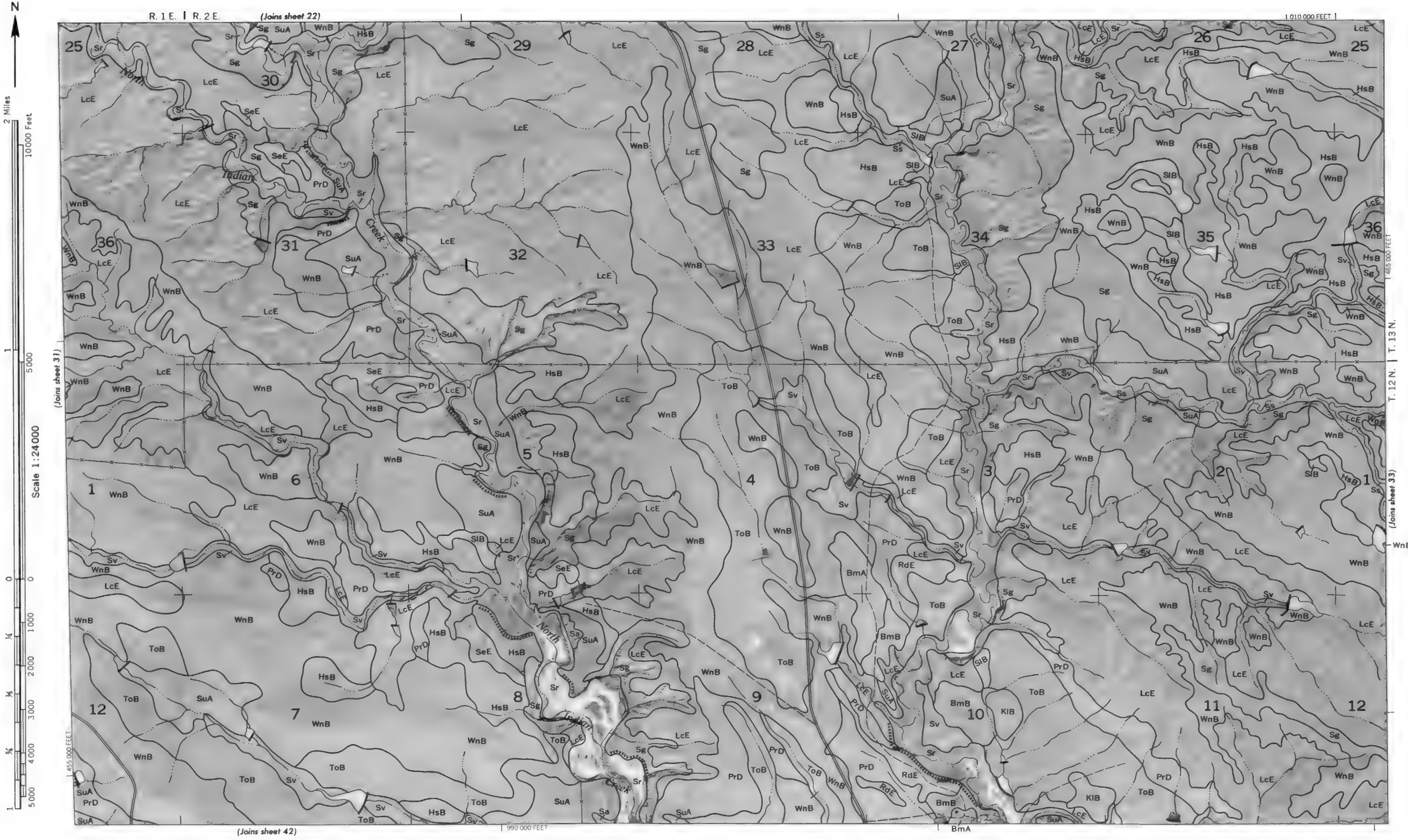
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

31

BUTTE COUNTY, SOUTH DAKOTA — SHEET NUMBER 31



This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 32

BUTTE COUNTY, SOUTH DAKOTA NO. 33

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

Land division corners are approximately positioned on this map

R. 2 E. | R. 3 E.

1 020 000 FEET

T. 12 N. | T. 13 N.

465 000 FEET

(Joins sheet 23)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 43)

1 040 000 FEET

455 000 FEET

Battle Creek

Antelope Creek

N

Scale 1:24000

2 Miles 1

10000 Feet 5000 0

N

2 Miles 10000 Feet

Scale 1:24000

1 0 1 0 5000 1000 5000 2000 3000 4000 5000

(Joins sheet 24) R. 3 E. | R. 4 E.

1 070 000 FEET

465 000 FEET

T. 12 N. | T. 13 N.

(Joins sheet 33)

455 000 FEET

(Joins sheet 35)

(Joins sheet 44)

1 050 000 FEET

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 35

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

R. 4 E. | R. 5 E.

1 080 000 FEET

1 090 000 FEET

465 000 FEET

455 000 FEET

T. 12 N. | T. 13 N.

(Joins sheet 25)

(Joins sheet 36)

(Joins sheet 34)

(Joins sheet 45)

N

2 Miles

10 000 Feet

1

5 000

Scale 1:24 000

0

1 000

¼

2 000

½

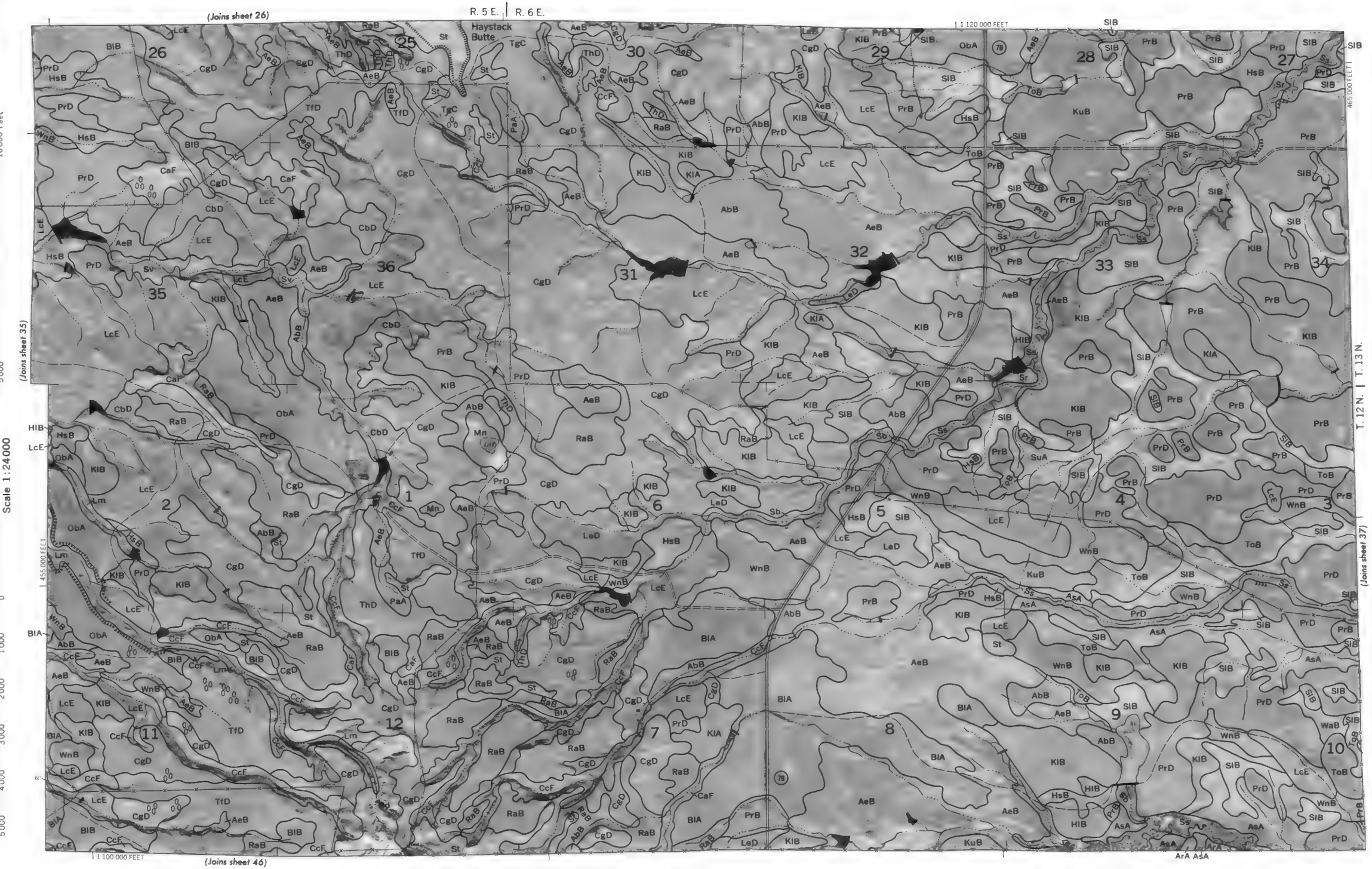
3 000

¾

4 000

1

5 000



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 37

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

1 130 000 FEET

R. 6 E. | R. 7 E.

(Joins sheet 27)

460 000 FEET

T. 12 N. | T. 13 N.

(Joins sheet 38)

(Joins sheet 36)

1 150 000 FEET

(Joins sheet 47)

N

2 Miles

10 000 Feet.

1

5 000

Scale 1:24 000

0 0

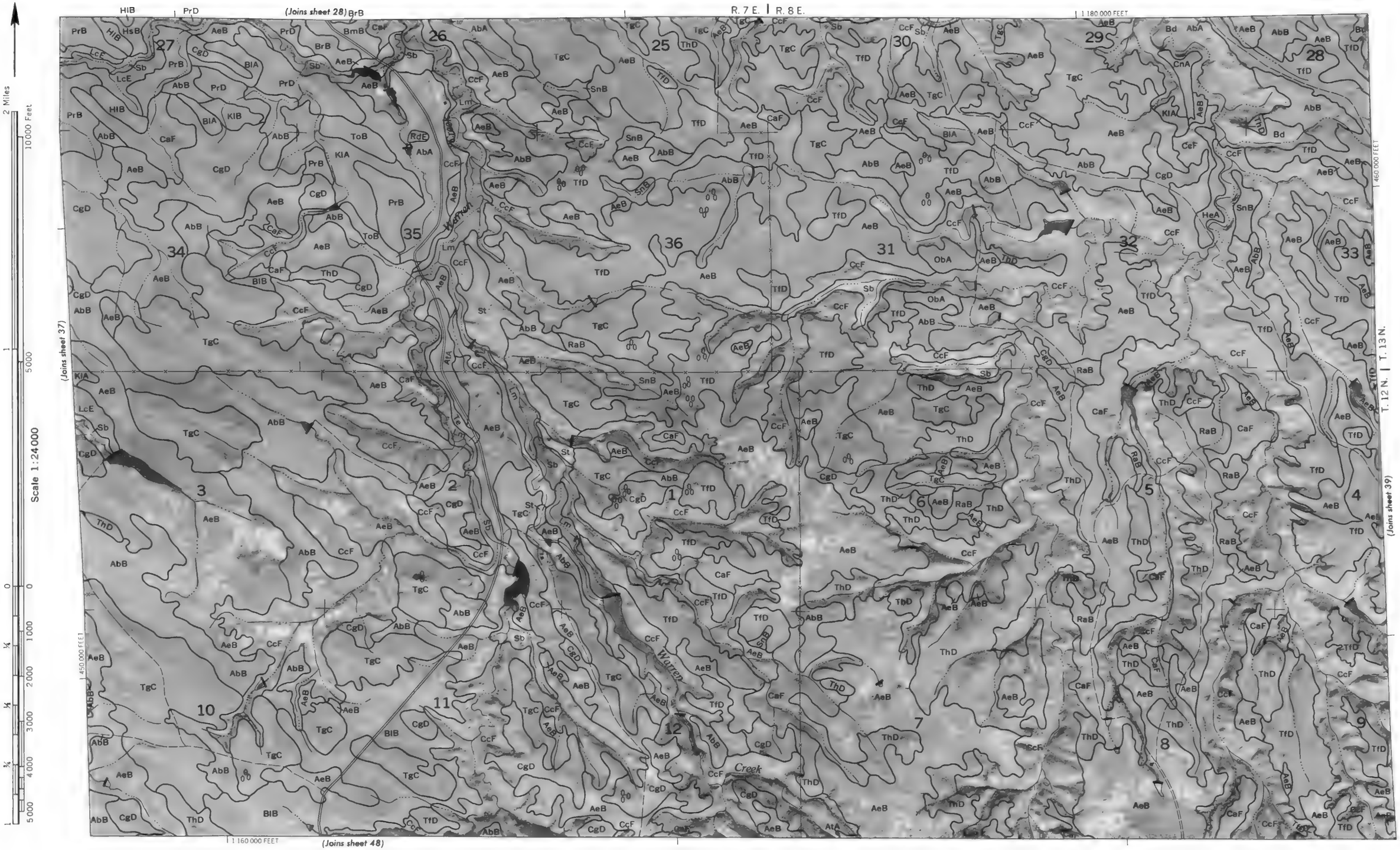
¼ ¼

½ ½

¾ ¾

1 1

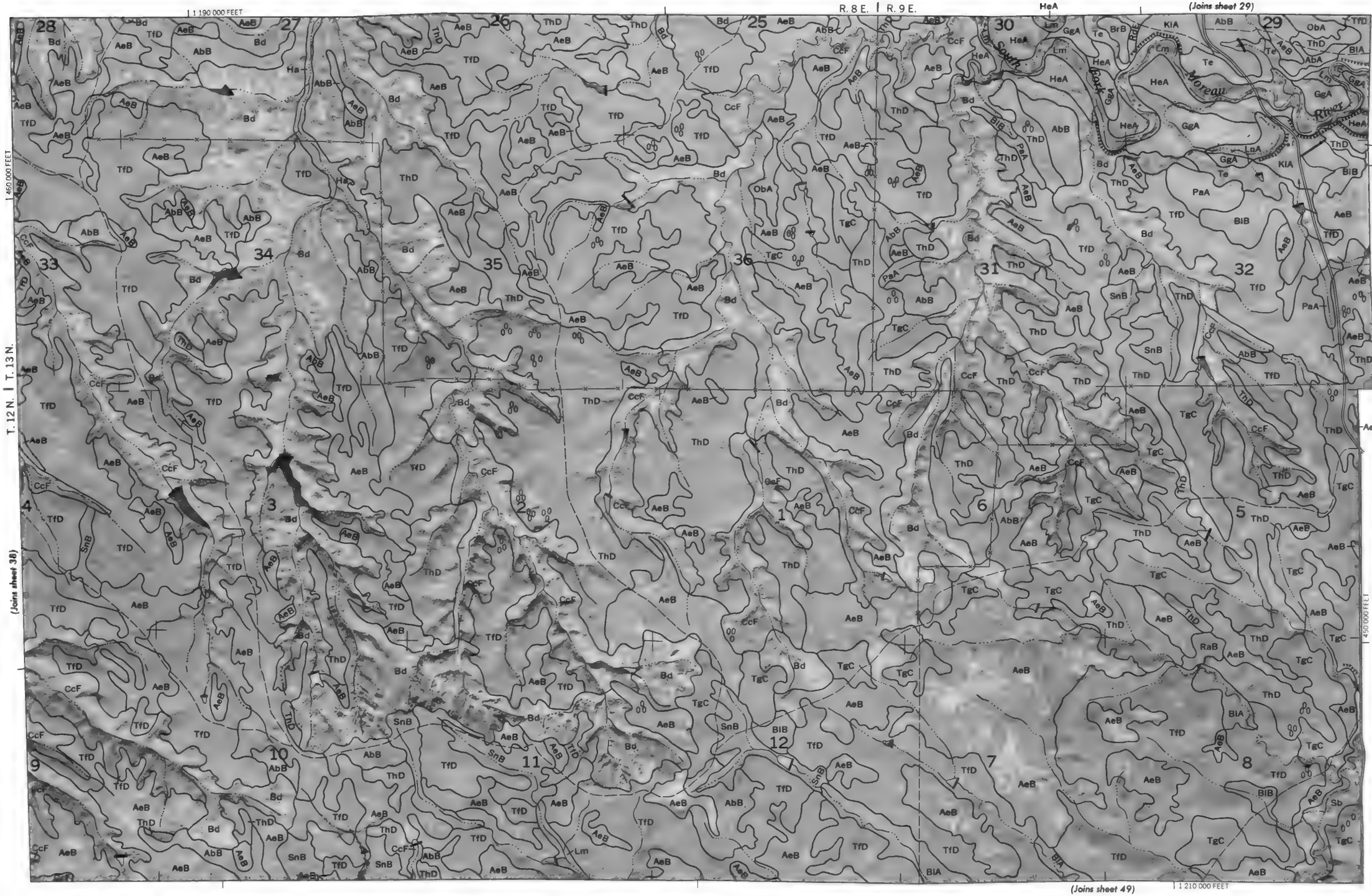
1 000 2 000 3 000 4 000 5 000

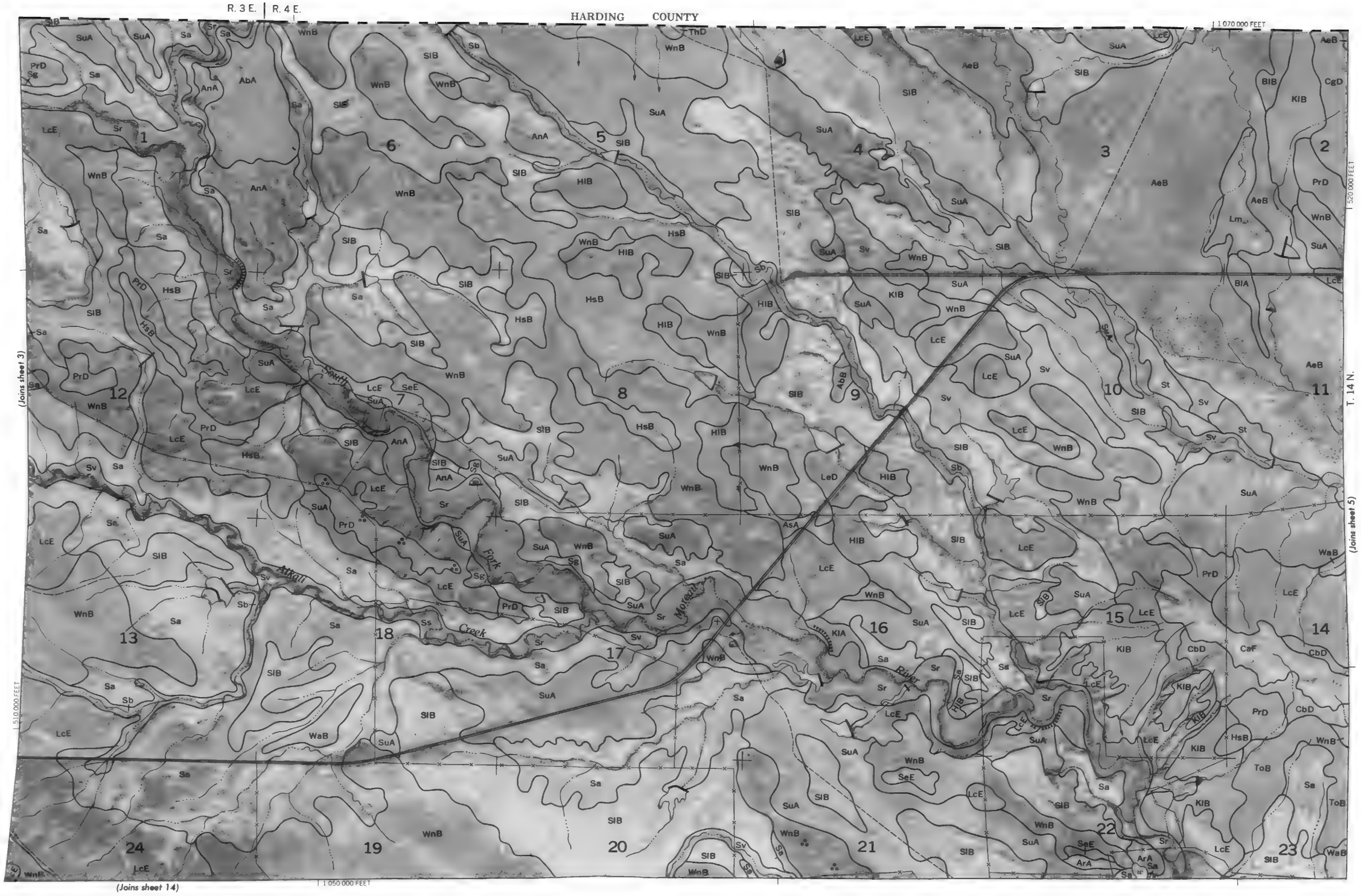


Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 39

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 4

N

Scale 1:24000

2 Miles 1 0 1 5000 0 10000 Feet

R. 9 E.

T. 13 N. PERKINS COUNTY

T. 12 N. MEADE COUNTY

1 240 000 FEET

455 000 FEET

445 000 FEET

1 220 000 FEET

(Joins sheet 30)

(Joins sheet 39)

(Joins sheet 50)

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 41

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

960 000 FEET

970 000 FEET

450 000 FEET

440 000 FEET

R. 1 E.

T. 12 N.

CARTER COUNTY

MONTANA

WYOMING

CROOK COUNTY

(Joins sheet 31)

(Joins sheet 42)

(Joins sheet 51)

Scale 1:24000

2 Miles

10000 Feet

5000

N

R. 1 E. | R. 2 E.

(Joins sheet 32)

1 010 000 FEET

450 000 FEET

T. 12 N.

(Joins sheet 41)

(Joins sheet 43)

440 000 FEET

980 000 FEET

(Joins sheet 52)

Scale 1:24 000

2 Miles 1 0

10000 Feet 5000 0

1 5000

⅛ 4000

¼ 3000

⅜ 2000

½ 1000

⅝ 0

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 43

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

R. 2 E. | R. 3 E.

1 020 000 FEET

1 450 000 FEET

T. 12 N.

(Joins sheet 33)

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 53)

1 030 000 FEET

440 000 FEET

N

Scale 1:24000

2 Miles 1 0

10000 Feet 5000 0

1 0 1000 2000 3000 4000 5000

N

R. 3 E. | R. 4 E.

(Joins sheet 34)

1 060 000 FEET

(Joins sheet 43)

445 000 FEET

T. 12 N.

(Joins sheet 45)

1 040 000 FEET

(Joins sheet 54)

Scale 1:24000

2 Miles 10000 Feet 5000 4000 3000 2000 1000 0

1 5000 4000 3000 2000 1000 0

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 45

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

1 070 000 FEET

445 000 FEET

R. 4 E. | R. 5 E.

T. 12 N.

(Joins sheet 35)

(Joins sheet 44)

(Joins sheet 46)

(Joins sheet 55)

1 090 000 FEET

435 000 FEET

Antelope Creek

Rocky Butte

N

2 Miles

10000 Feet

Scale 1:24000

N

R. 5 E. | R. 6 E.

T. 12 N.

1 120 000 FEET

445 000 FEET

435 000 FEET

1 100 000 FEET

(Joins sheet 36)

(Joins sheet 45)

(Joins sheet 47)

(Joins sheet 56)

Castle Rock Butte

Castle Rock

Frog Creek

2 Miles

10000 Feet

5000

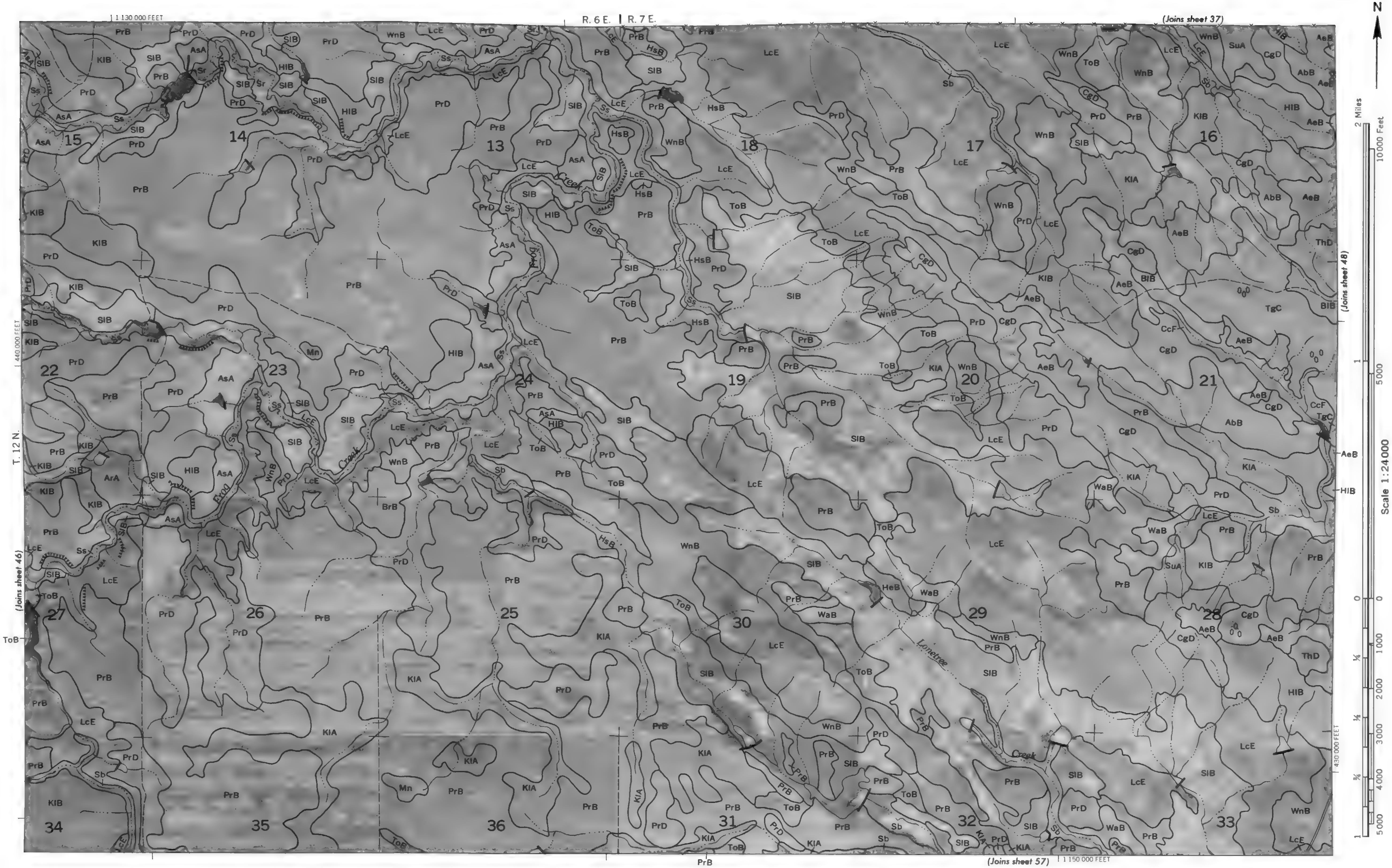
Scale 1:24000

0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.



BUTTE COUNTY, SOUTH DAKOTA NO. 47
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

(48)

N

R. 7 E. | R. 8 E.

1 180 000 FEET

1 440 000 FEET

T. 12 N.

(Joins sheet 38)

(Joins sheet 47)

(Joins sheet 49)

(Joins sheet 58)

1 160 000 FEET

2 Miles

10000 Feet

Scale 1:24000

Land division corners are approximately positioned on this map.

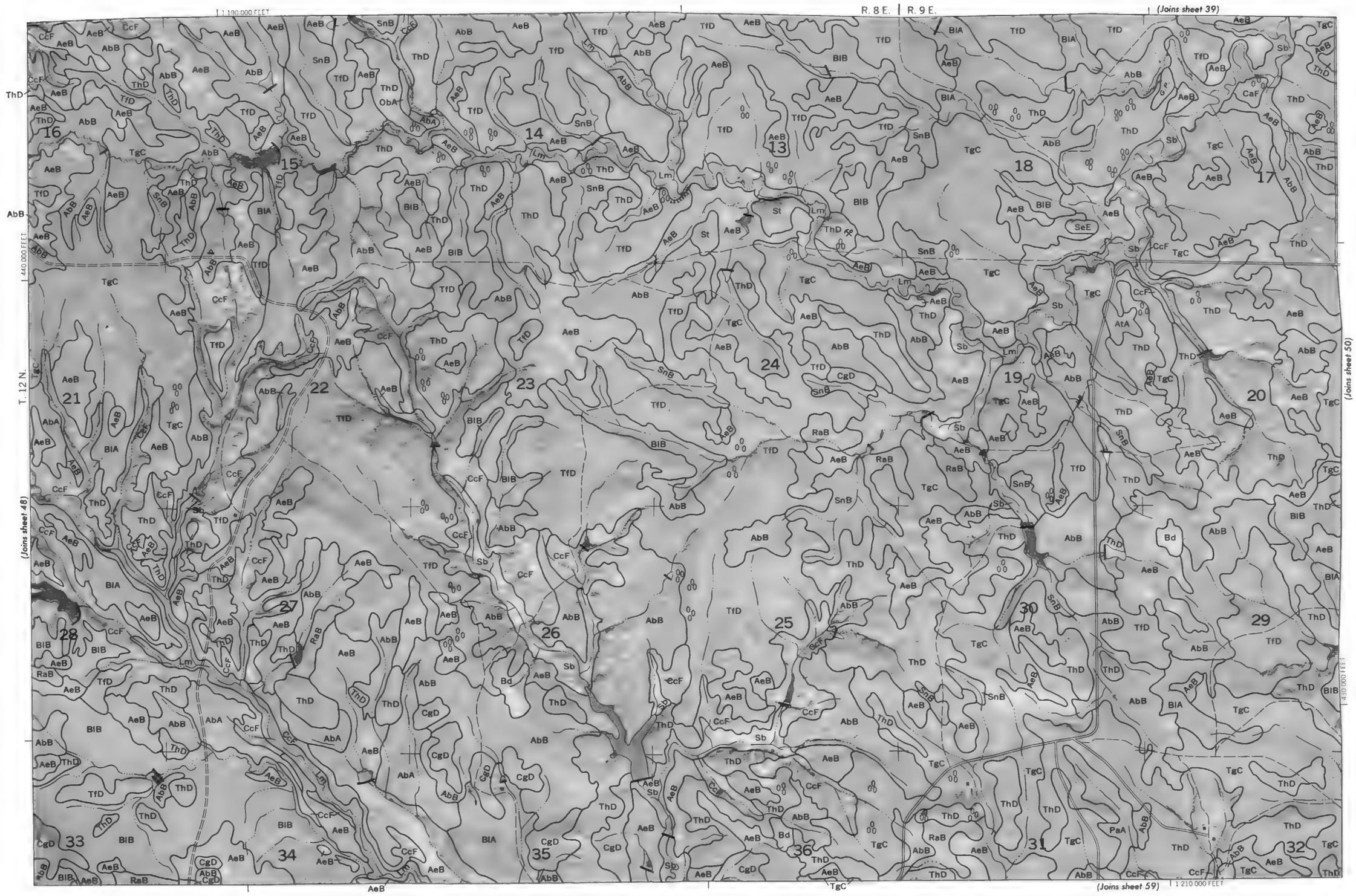
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 48

BUTTE COUNTY, SOUTH DAKOTA NO. 49

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



BUTTE COUNTY, SOUTH DAKOTA NO. 5

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

1 080 000 FEET | R. 4 E. | R. 5 E. HARDING COUNTY

1 520 000 FEET

T. 14 N.

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 15)

1 100 000 FEET

N

2 Miles 1 0 10000 Feet

Scale 1:24000

1 0 ¼ ½ ¾ 1 5000 0 1000 2000 3000 4000 5000 1 510 000 FEET

50

N

(Joins sheet 40) ThD Bd R. 9 E. 1 240 000 FEET

(Joins sheet 49)

T. 12 N.

440 000 FEET

430 000 FEET

COUNTY

MEADE

(Joins sheet 60) 1 220 000 FEET

Scale 1:24000

2 Miles 10000 Feet

1 5000 0

½ 2000 1000

½ 3000

½ 4000

1 5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 50

BUTTE COUNTY, SOUTH DAKOTA NO. 51

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

960 000 FEET

430 000 FEET

970 000 FEET

R. 1 E.

T. 11 N. | T. 12 N.

WYOMING

CROOK COUNTY

(Joins sheet 41)

(Joins sheet 52)

(Joins sheet 61)

Owl Creek

2 Miles

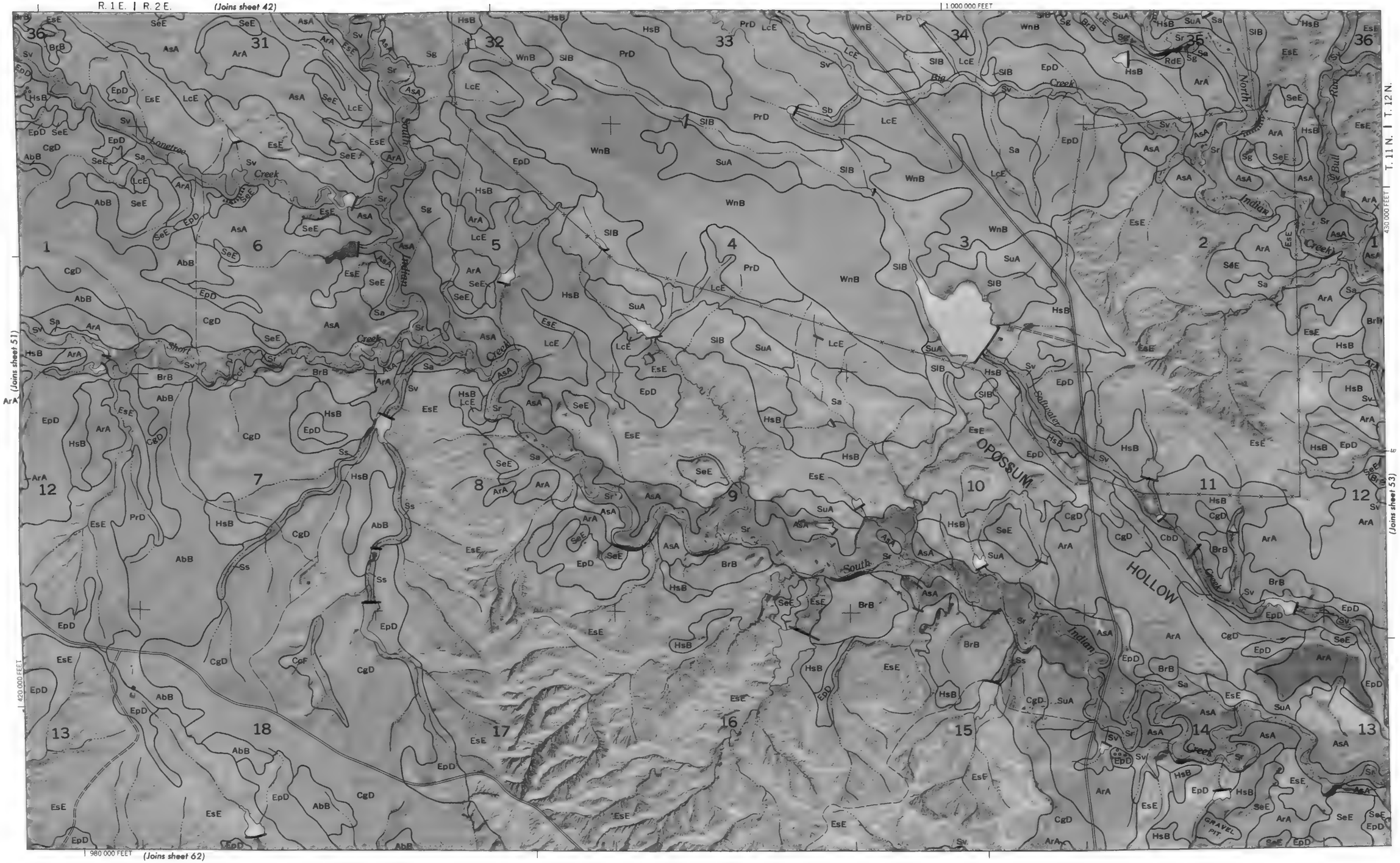
10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

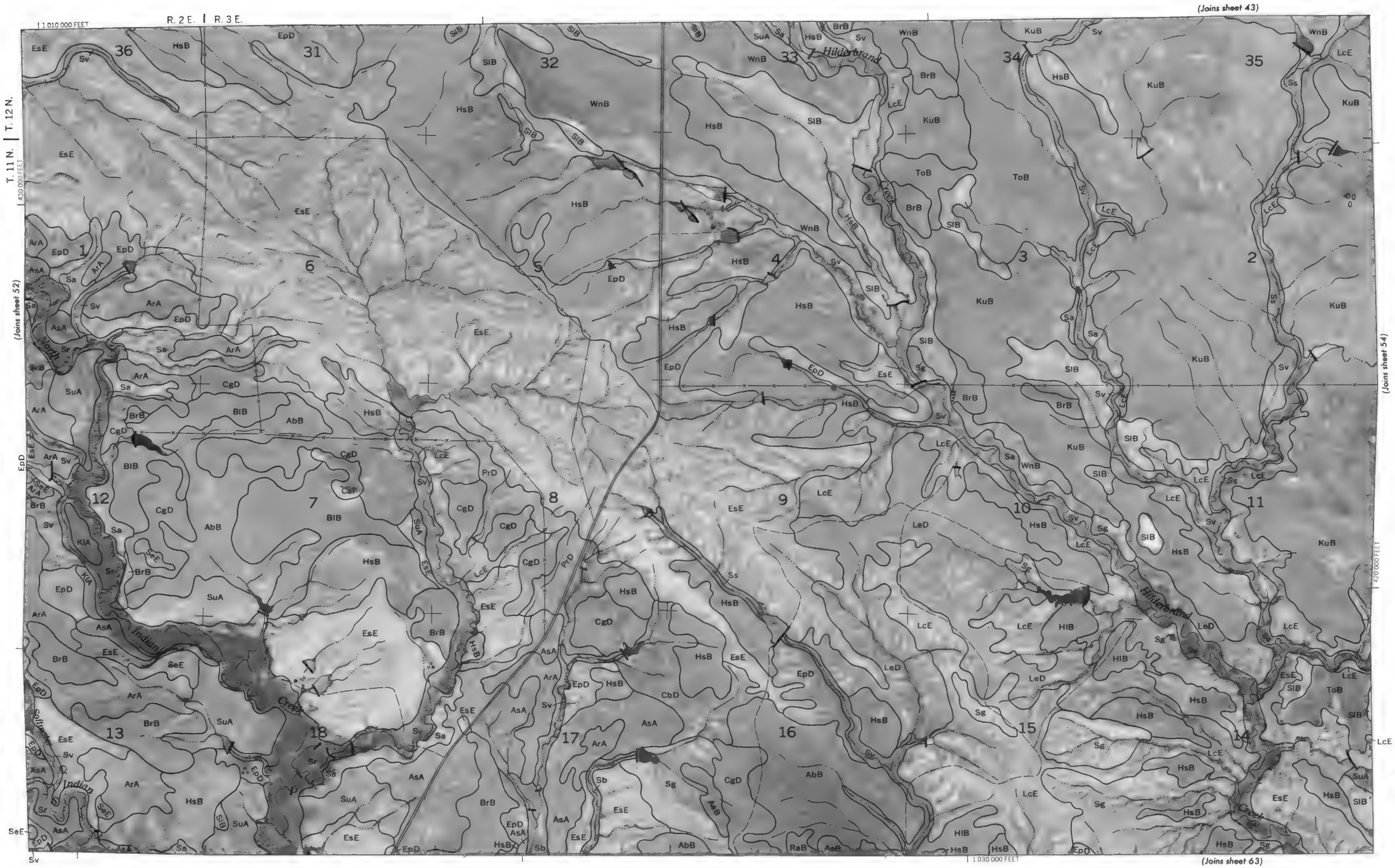


This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

BUTTE COUNTY, SOUTH DAKOTA NO. 52

BUTTE COUNTY, SOUTH DAKOTA NO. 53

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



54

N

R. 3 E. | R. 4 E. (Joins sheet 44)

T. 11 N. | T. 12 N.

1 060 000 FEET

430 000 FEET

420 000 FEET

1 040 000 FEET

(Joins sheet 53)

(Joins sheet 64)

(Joins sheet 55)

2 Miles 10000 Feet

Scale 1:24000

1 5000 0

½ 1000 0

½ 2000

¾ 3000

¾ 4000

1 5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 54

BUTTE COUNTY, SOUTH DAKOTA NO. 55

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photo[illegible] from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
Land division corners are approximately [illegible] tioned on this map.

1 070 000 FEET
430 000 FEET
R. 4 E. | R. 5 E.
T. 11 N. | T. 12 N.
(Joins sheet 45)
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 65)
1 090 000 FEET
1 420 000 FEET

N

2 Miles
10000 Feet
1
5000
0
Scale 1:24000
1 000
2000
3000
4000
5000
0
¼
½
¾
1
¼
½
¾
1

35 36 31 32 33 34
2 1 6 5 4 3
11 12 7 8 9 10
14 13 18 17 16 15

St KlB SuA SlB WaB Sv HsB LcE Ss Sa WnB PrD ToB Sr Mn

N

Scale 1:24000

2 Miles 1

10000 Feet 5000 0

0 1000 2000 3000 4000 5000

(Joins sheet 46)

R. 5 E. | R. 6 E.

1 120 000 FEET

T. 11 N. | T. 12 N.

425 000 FEET

415 000 FEET

1 100 000 FEET

(Joins sheet 55)

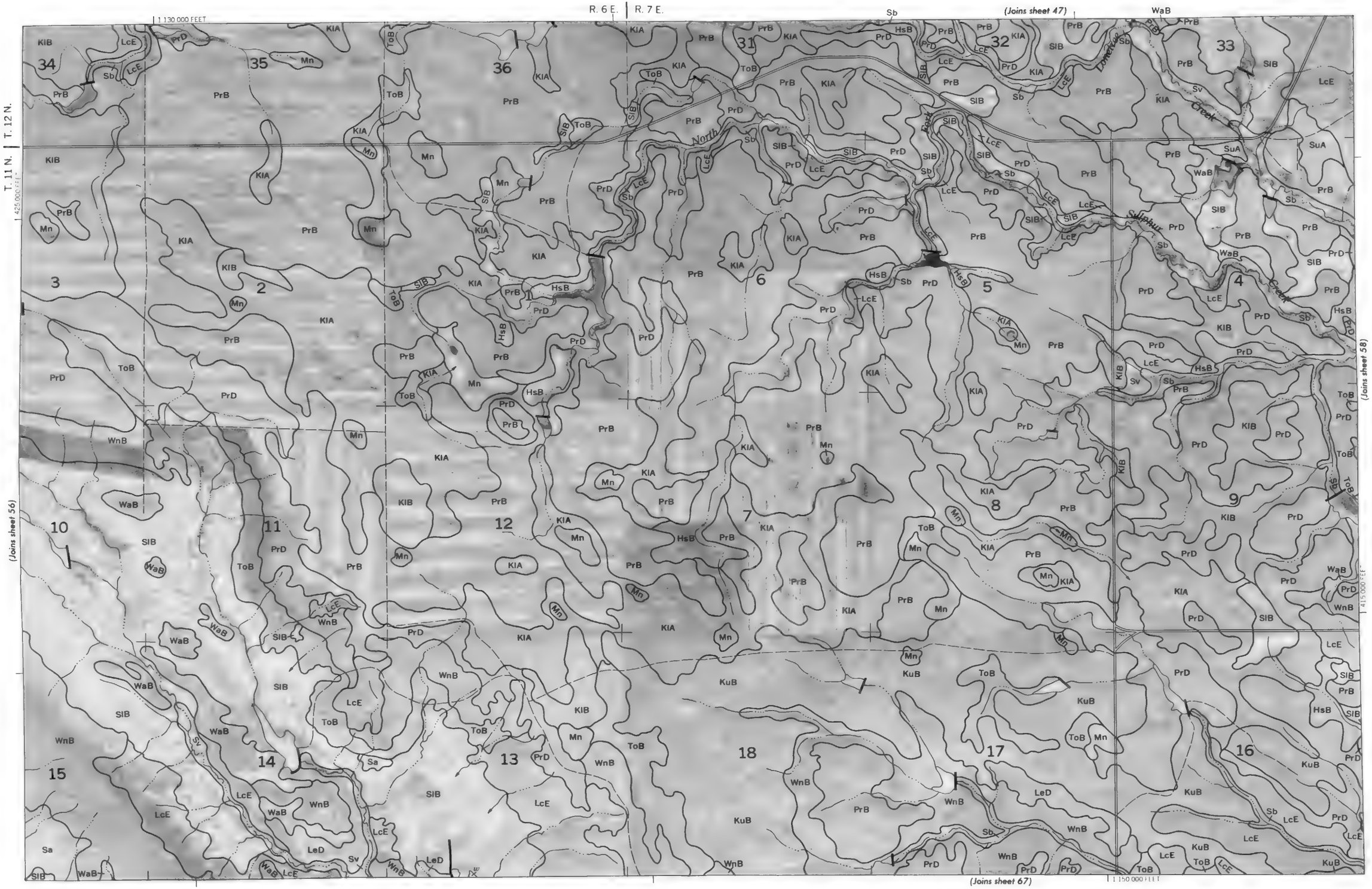
(Joins sheet 57)

(Joins sheet 66)

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.



BUTTE COUNTY, SOUTH DAKOTA NO. 57

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

Scale 1:24000

2 Miles 1 0 5000 0 10000 Feet

¼ ¼ ¾ 1 5000 4000 3000 2000 1000 0

R. 7 E. | R. 8 E.

T. 11 N. | T. 12 N.

(Joins sheet 48)

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 68)

1 180 000 FEET

425 000 FEET

415 000 FEET

1 160 000 FEET

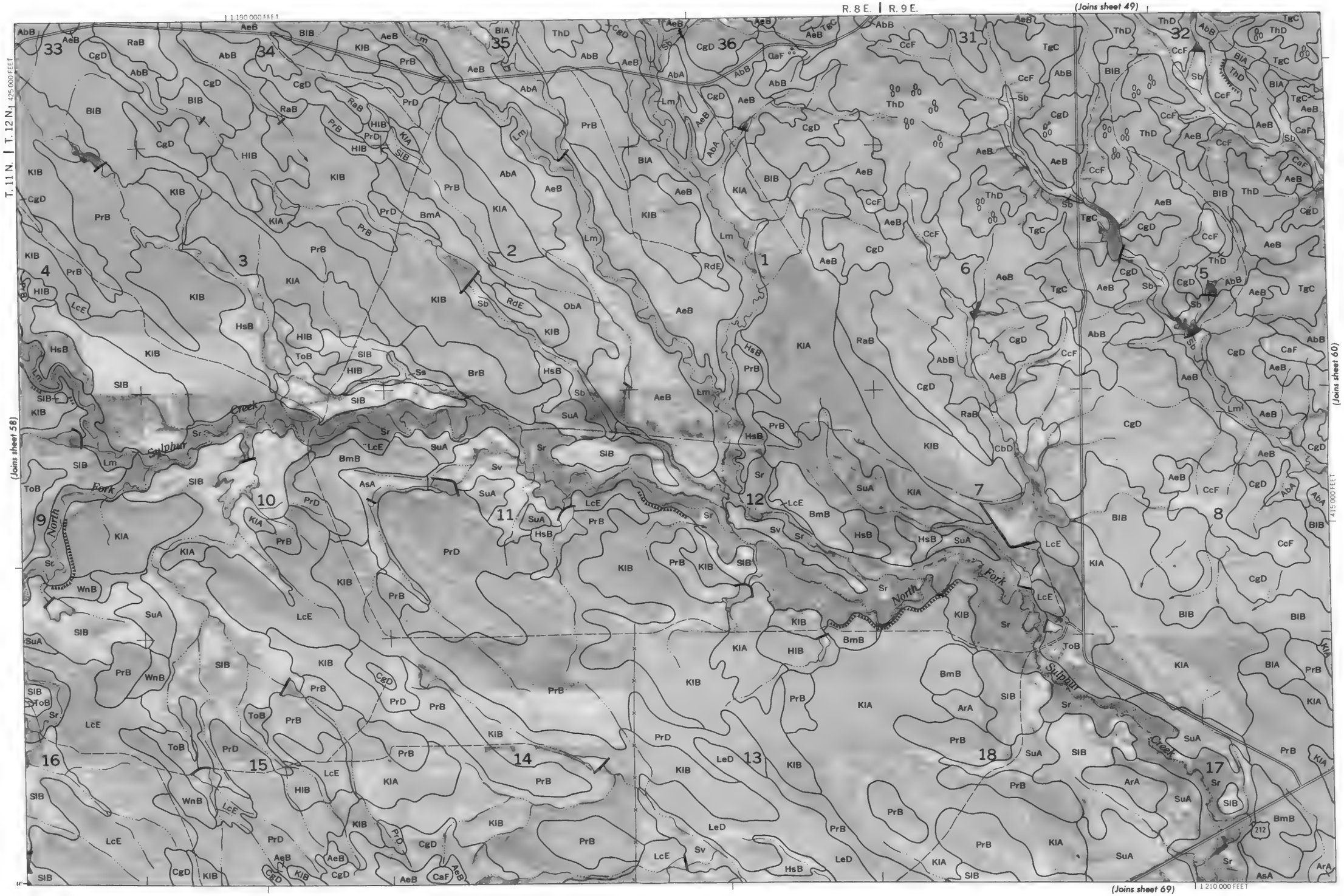
Land division corners are approximately positioned on this map.

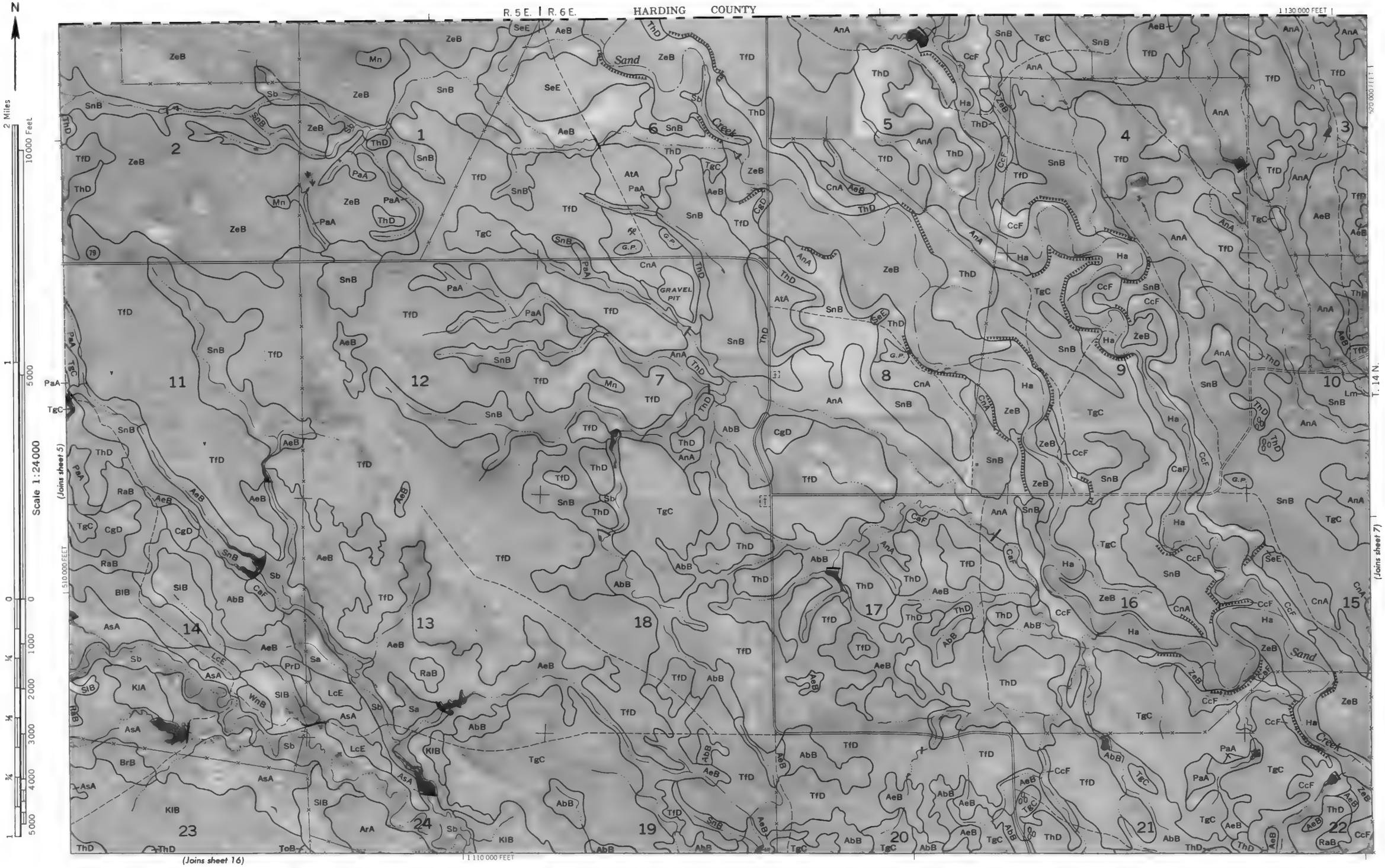
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 59

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map





Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

N

Scale 1:24000

2 Miles 10000 Feet

1 5000

¼ 0 0

¼ 1000 1000

¼ 2000 2000

¾ 3000 3000

¾ 4000 4000

1 5000

(Joins sheet 50)

(Joins sheet 59)

(Joins sheet 70)

R. 9 E.

T. 11 N.

T. 12 N.

MEADE COUNTY

1 240 000 FEET

420 000 FEET

410 000 FEET

1 220 000 FEET

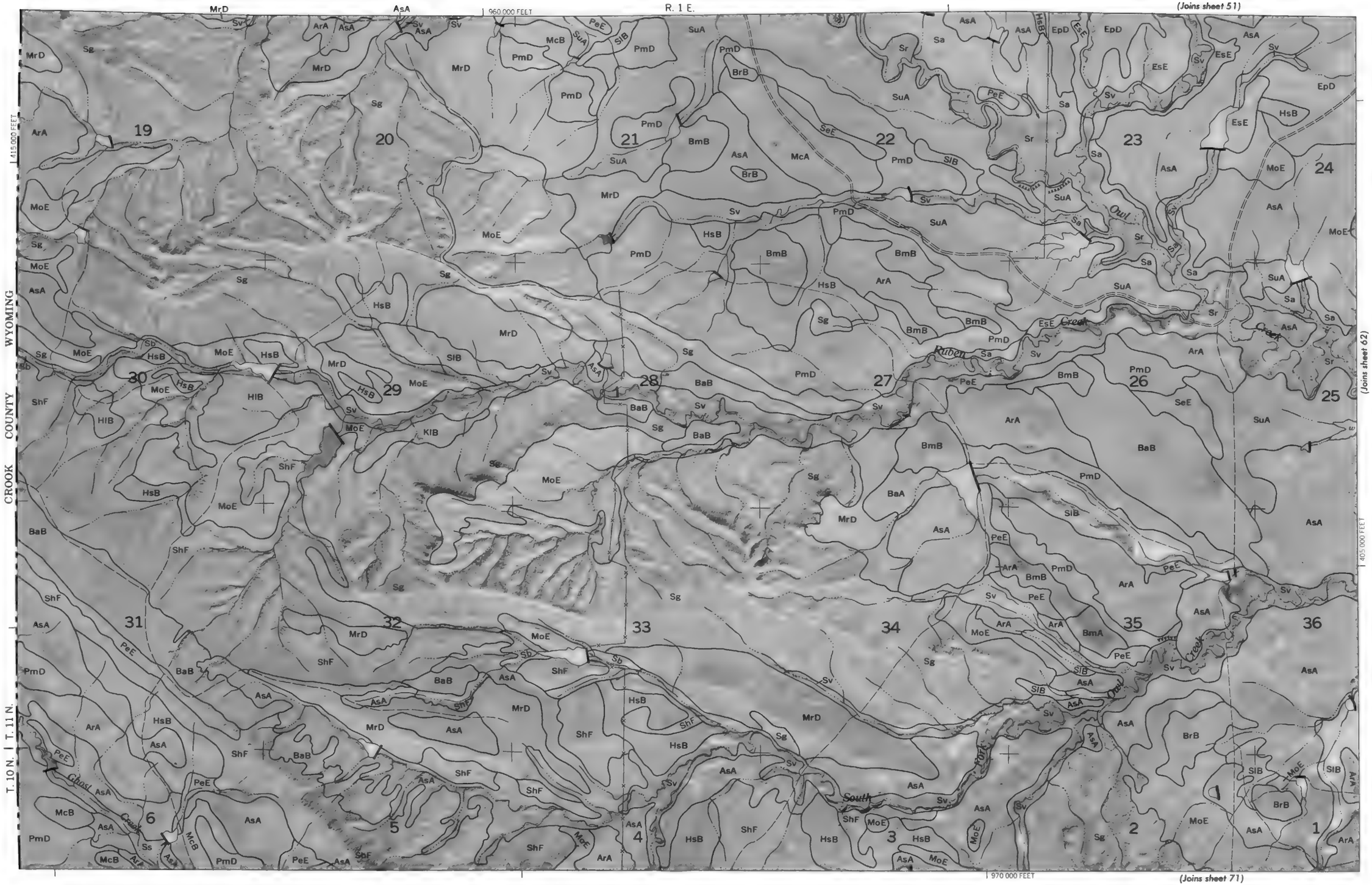
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 61

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



62

N

R. 1 E. | R. 2 E.

(Joins sheet 52)

1 000 000 FEET

405 000 FEET

(Joins sheet 61)

(Joins sheet 63)

980 000 FEET

(Joins sheet 72)

KIA

T. 10 N. | T. 11 N.

2 Miles

10000 Feet

Scale 1:24000

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

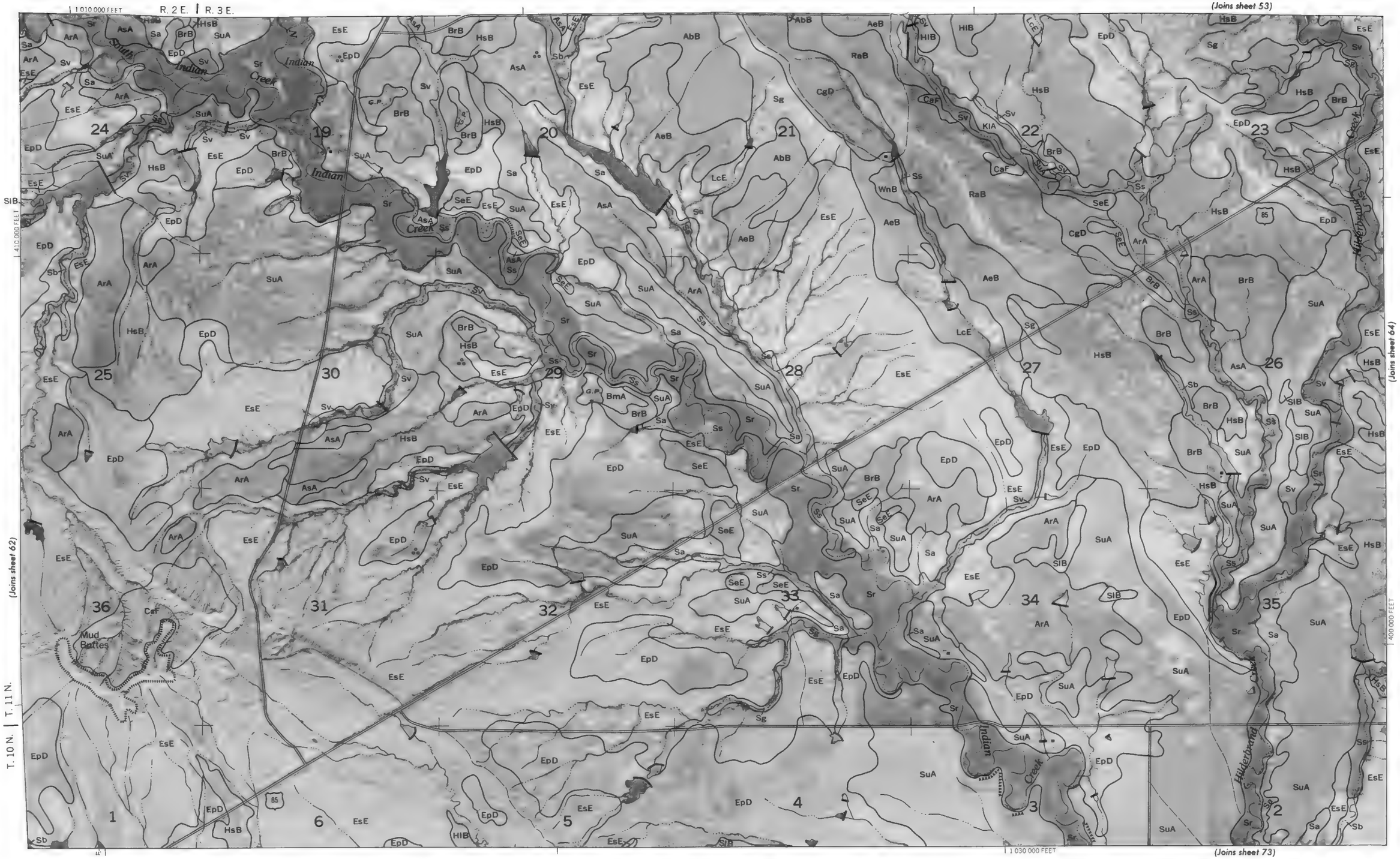
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 62

BUTTE COUNTY, SOUTH DAKOTA NO. 63

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
1,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximately positioned on this map.
Land division corners are approximately positioned on this map.



N

R. 3 E. | R. 4 E. (Joins sheet 54)

1 060 000 FEET

410 000 FEET

400 000 FEET

1 040 000 FEET

(Joins sheet 63)

(Joins sheet 74)

(Joins sheet 65)

T. 10 N. | T. 11 N.

2 Miles

10000 Feet

Scale 1:24000

1 0 1 2 3 4 5 Miles

1 0 1 2 3 4 5 Kilometers

5000 0 5000 10000 15000 20000 25000 30000 35000 40000 45000 50000 55000 60000 65000 70000 75000 80000 Feet

1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 Kilometers

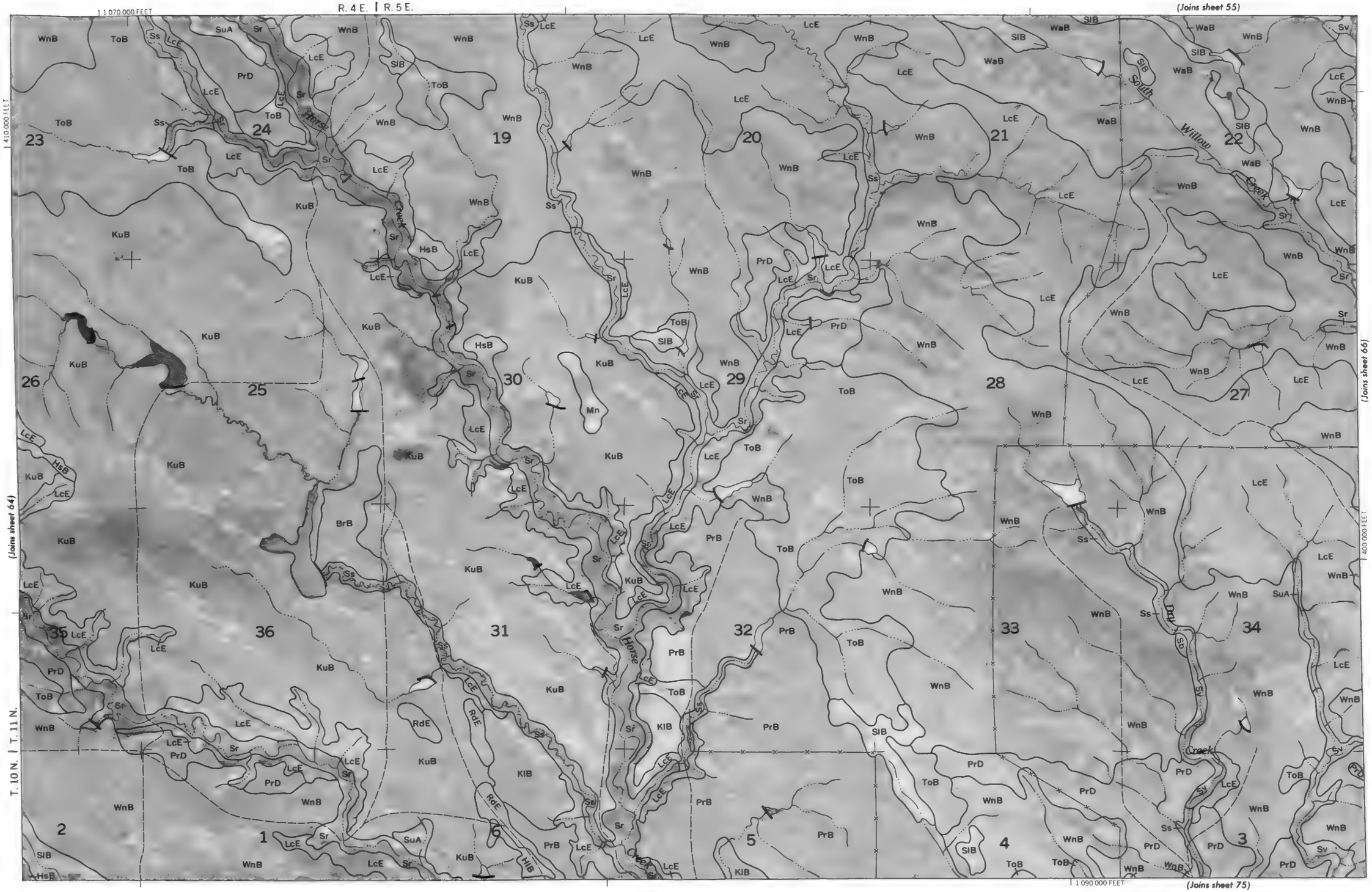
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 65

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



N

Scale 1:24000

2 Miles 1 0 10000 Feet 5000 0

5000 4000 3000 2000 1000 0

(Joins sheet 56) R. 5 E. | R. 6 E.

1 120 000 FEET

405 000 FEET

395 000 FEET

1 100 000 FEET

(Joins sheet 65)

(Joins sheet 67)

(Joins sheet 76)

T. 10 N. | T. 11 N.

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 66

BUTTE COUNTY, SOUTH DAKOTA NO. 67

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

R. 6 E. | R. 7 E.

1 130 000 FEET

405 000 FEET

T. 10 N. | T. 11 N.

(Joins sheet 66)

(Joins sheet 57)

(Joins sheet 68)

(Joins sheet 77)

1 150 000 FEET

395 000 FEET

N

2 Miles

10000 Feet

5000

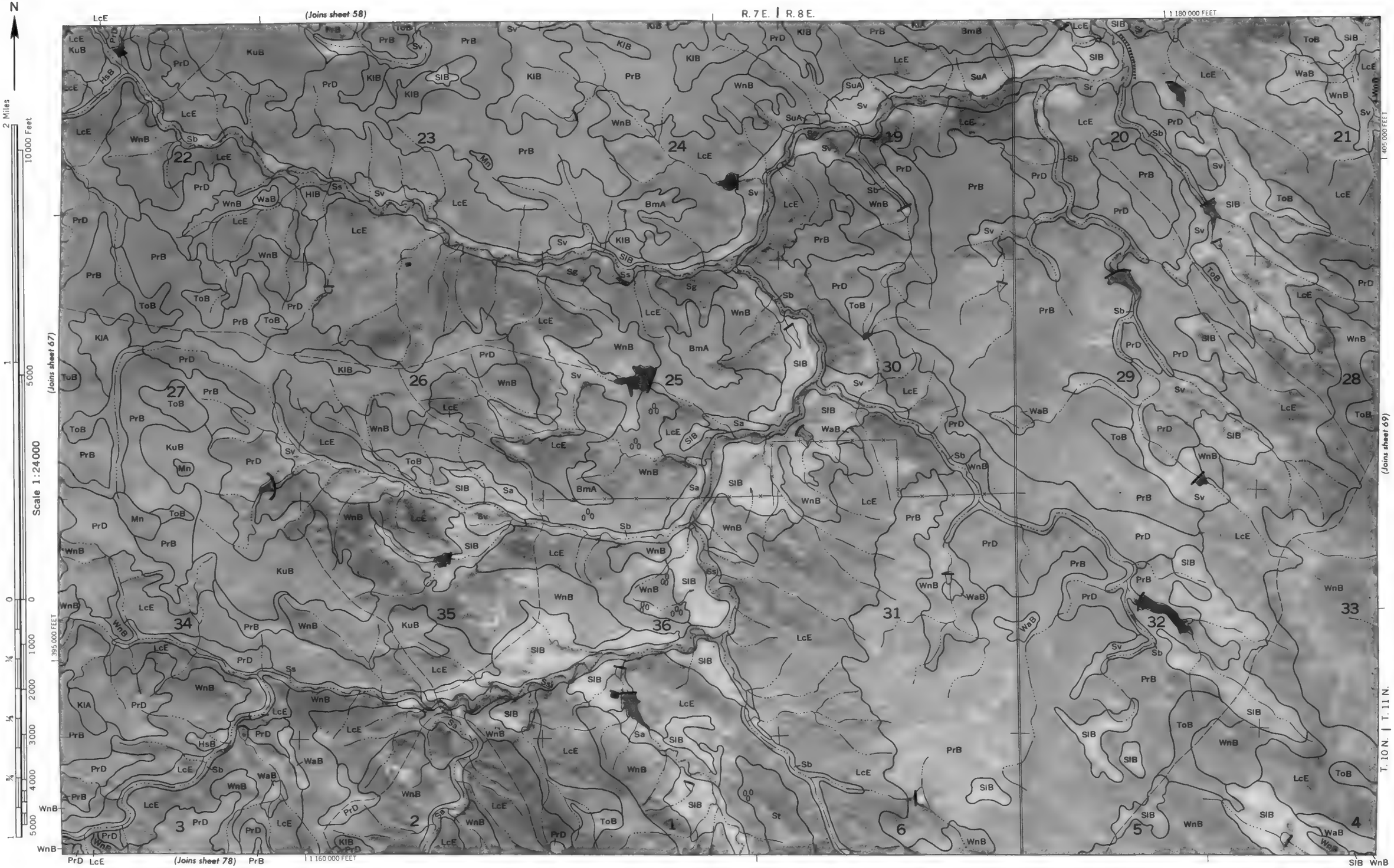
1

Scale 1:24000

0 1000 2000 3000 4000 5000

Willow Creek

North



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 68

BUTTE COUNTY, SOUTH DAKOTA NO. 69

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

R. 8 E. | R. 9 E.

T. 10 N. | T. 11 N.

1 190 000 FEET

405 000 FEET

395 000 FEET

1 210 000 FEET

(Joins sheet 59)

(Joins sheet 68)

(Joins sheet 70)

(Joins sheet 79)

N

2 Miles

10000 Feet

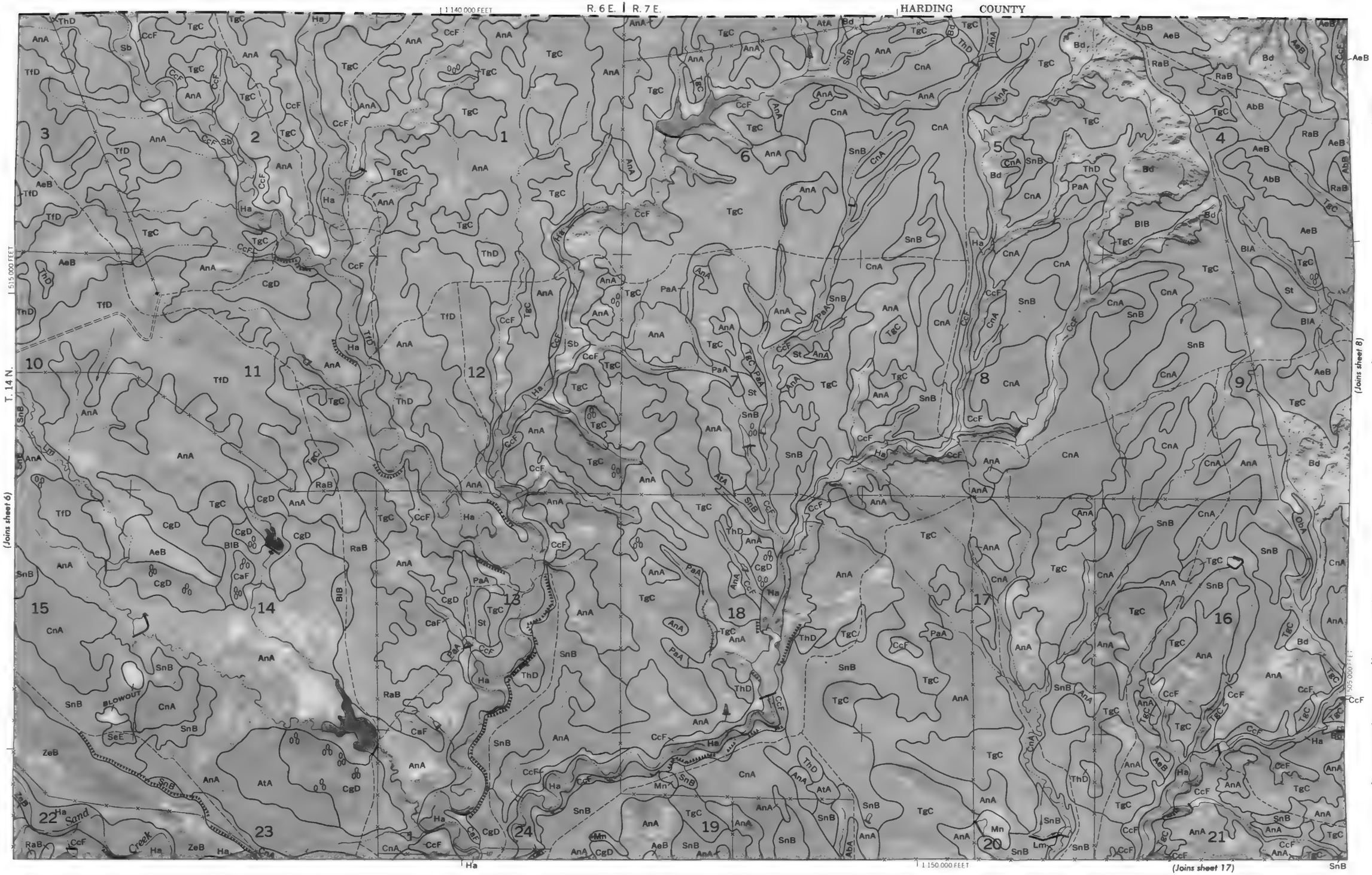
1

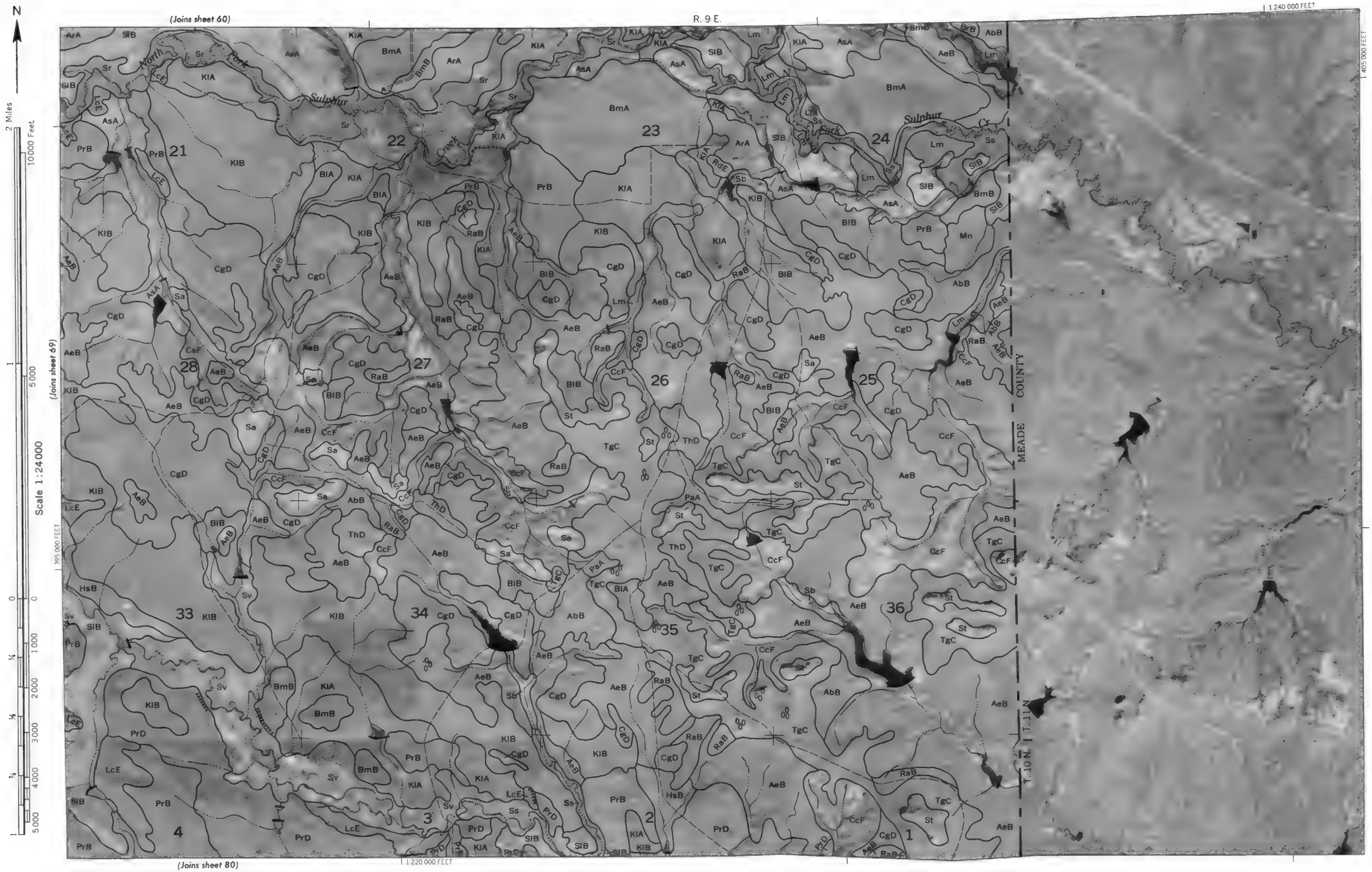
5000

Scale 1:24000

BUTTE COUNTY, SOUTH DAKOTA NO. 7

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 70

BUTTE COUNTY, SOUTH DAKOTA NO. 71

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

950 000 FEET

R. 1 E.

(Joins sheet 61)

T. 10 N.

395 000 FEET

WYOMING

CROOK COUNTY

385 000 FEET

970 000 FEET

(Joins sheet 72)

(Joins sheet 81)

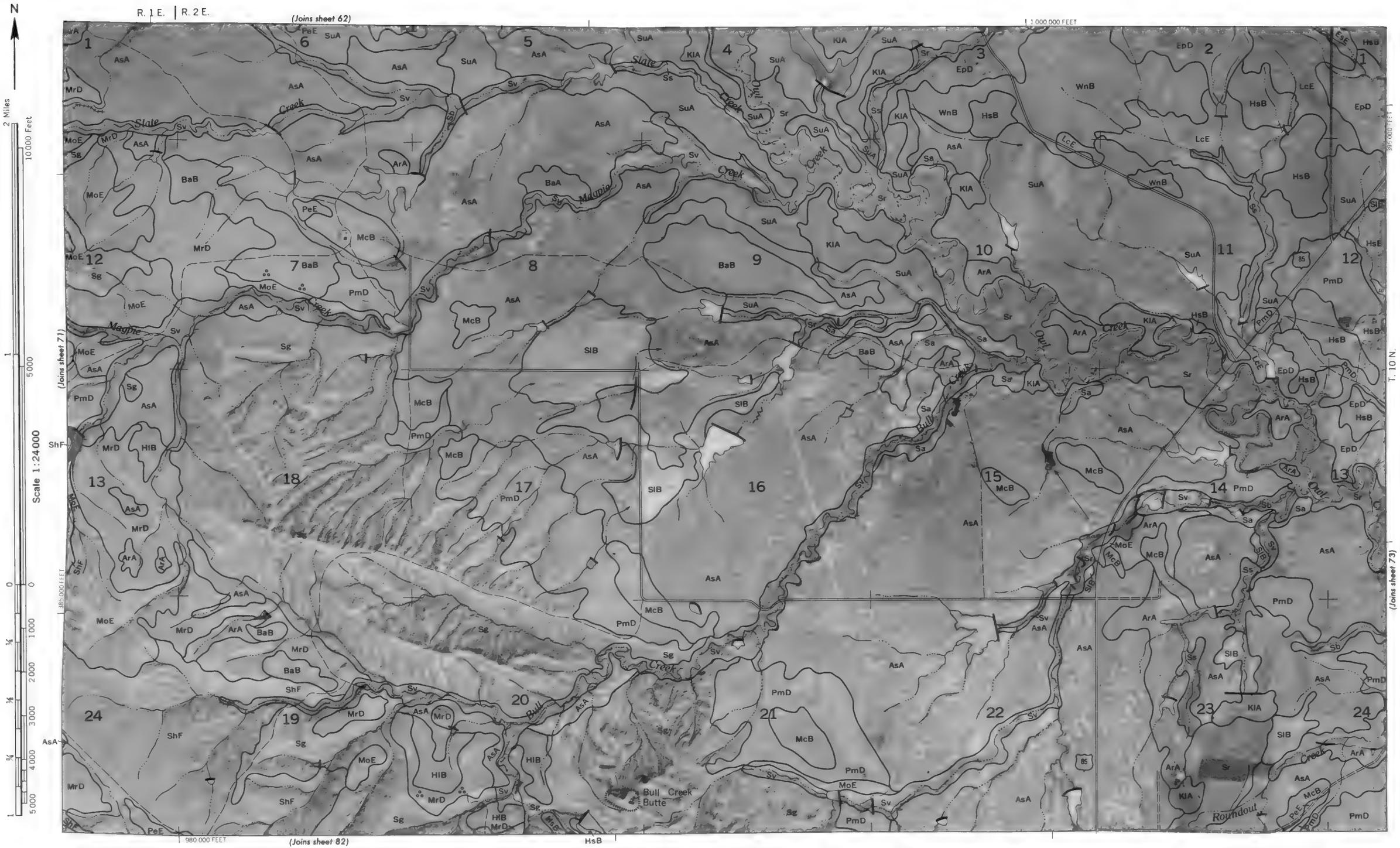
N

2 Miles

10000 Feet

5000

Scale 1:24000



This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 72

BUTTE COUNTY, SOUTH DAKOTA NO. 73

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
Land division corners are approximately positioned on this map.

R. 2 E. | R. 3 E.

1 010 000 FEET

395 000 FEET

T. 10 N.

(Joins sheet 72)

(Joins sheet 63)

(Joins sheet 74)

1 030 000 FEET

385 000 FEET

(Joins sheet 83)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

N

R. 3 E. | R. 4 E. (Joins sheet 64)

1 050 000 FEET

390 000 FEET

T. 10 N.

(Joins sheet 73)

(Joins sheet 75)

380 000 FEET

1 040 000 FEET

(Joins sheet 84)

2 Miles 10000 Feet

Scale 1:24000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 74

BUTTE COUNTY, SOUTH DAKOTA NO. 75

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

1 070 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 65)

390 000 FEET

T. 10 N.

(Joins sheet 74)

(Joins sheet 76)

(Joins sheet 85)

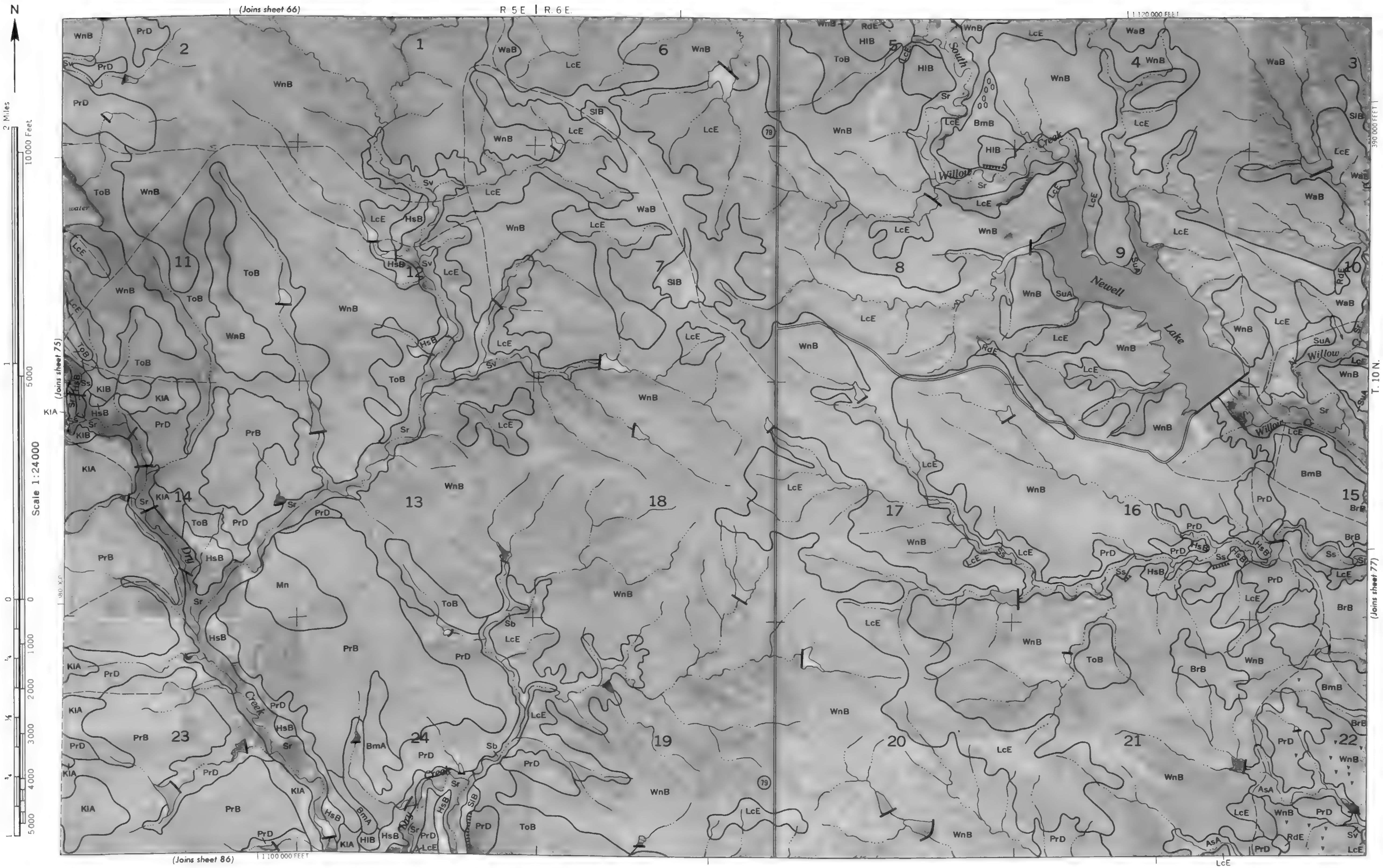
1 090 000 FEET

N

2 Miles 1 0 10000 Feet

Scale 1:24000

1 0 1000 2000 3000 4000 5000



Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 77

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

1 130 000 FEET

R. 6 E. | R. 7 E.

(Joins sheet 67)

390 000 FEET

T. 10 N.

(Joins sheet 76)

(Joins sheet 78)

380 000 FEET

(Joins sheet 87)

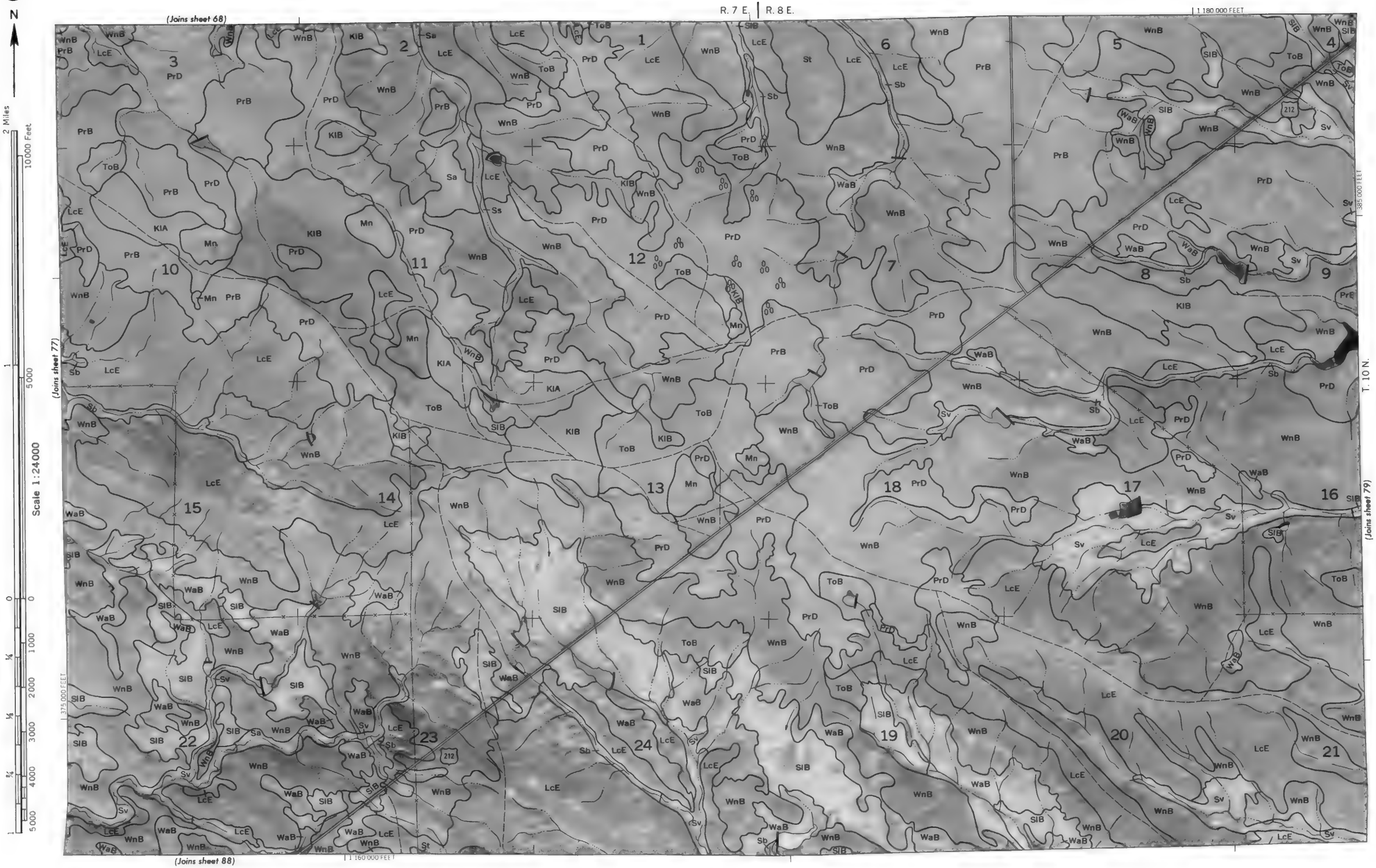
1 150 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000



Land division corners are approximately positioned on this map.

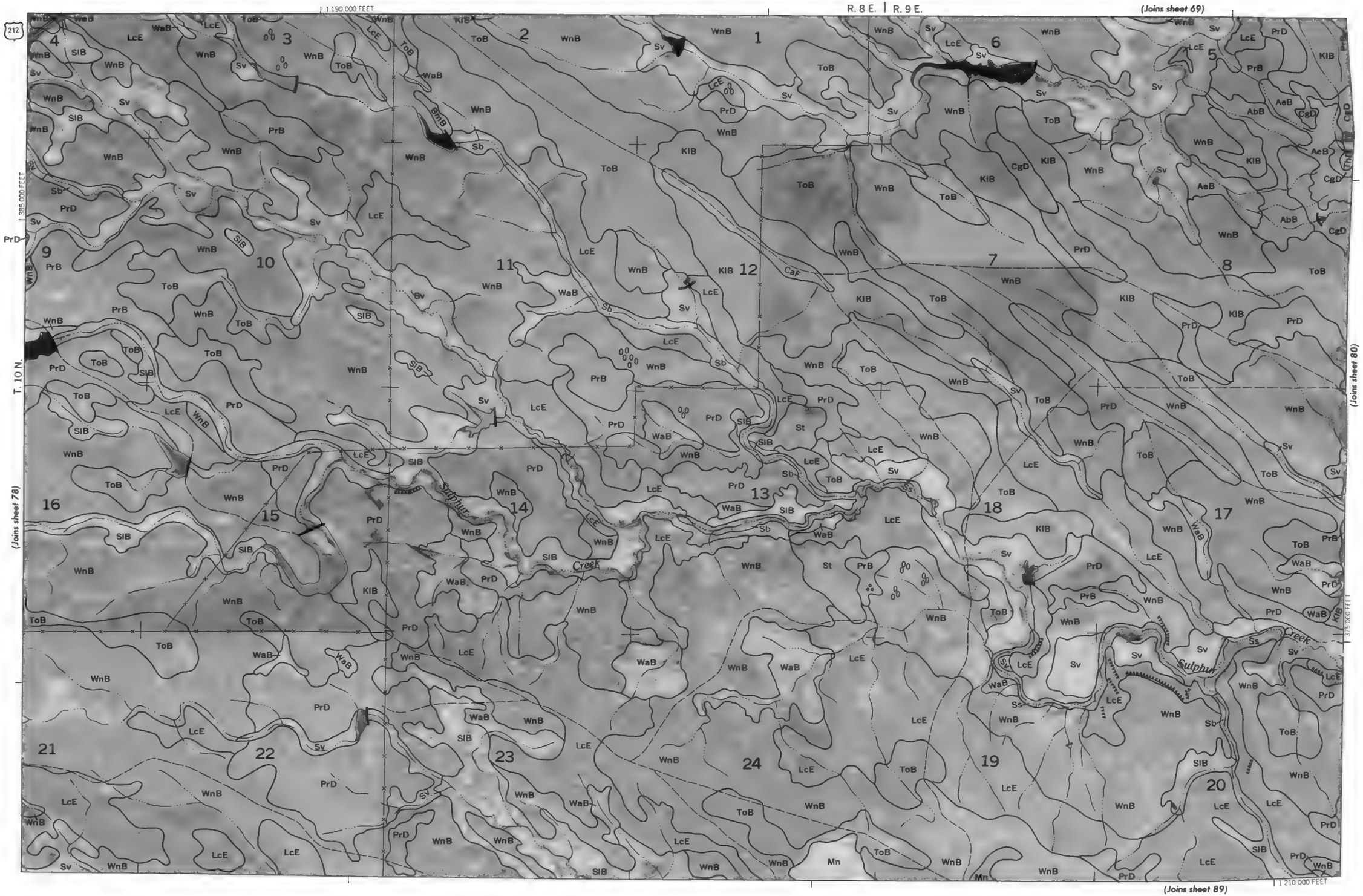
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 78

BUTTE COUNTY, SOUTH DAKOTA NO. 79

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



(8)

N

HARDING COUNTY

R. 7 E. | R. 8 E.

1 180 000 FEET

515 000 FEET

T. 14 N.

T. 13 N.

500 000 FEET

1 160 000 FEET

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 18)

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 1000 2000 3000 4000 5000

¼ ½ ¾

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

N

(Joins sheet 70)

R. 9 E.

1 240 000 FEET

385 000 FEET

(Joins sheet 79)

T. 10 N.

MEADE COUNTY

Sulphur Creek

(Joins sheet 90)

1 220 000 FEET

2 Miles

10000 Feet

Scale 1:24000

Land division corners are approximately positioned on this map.

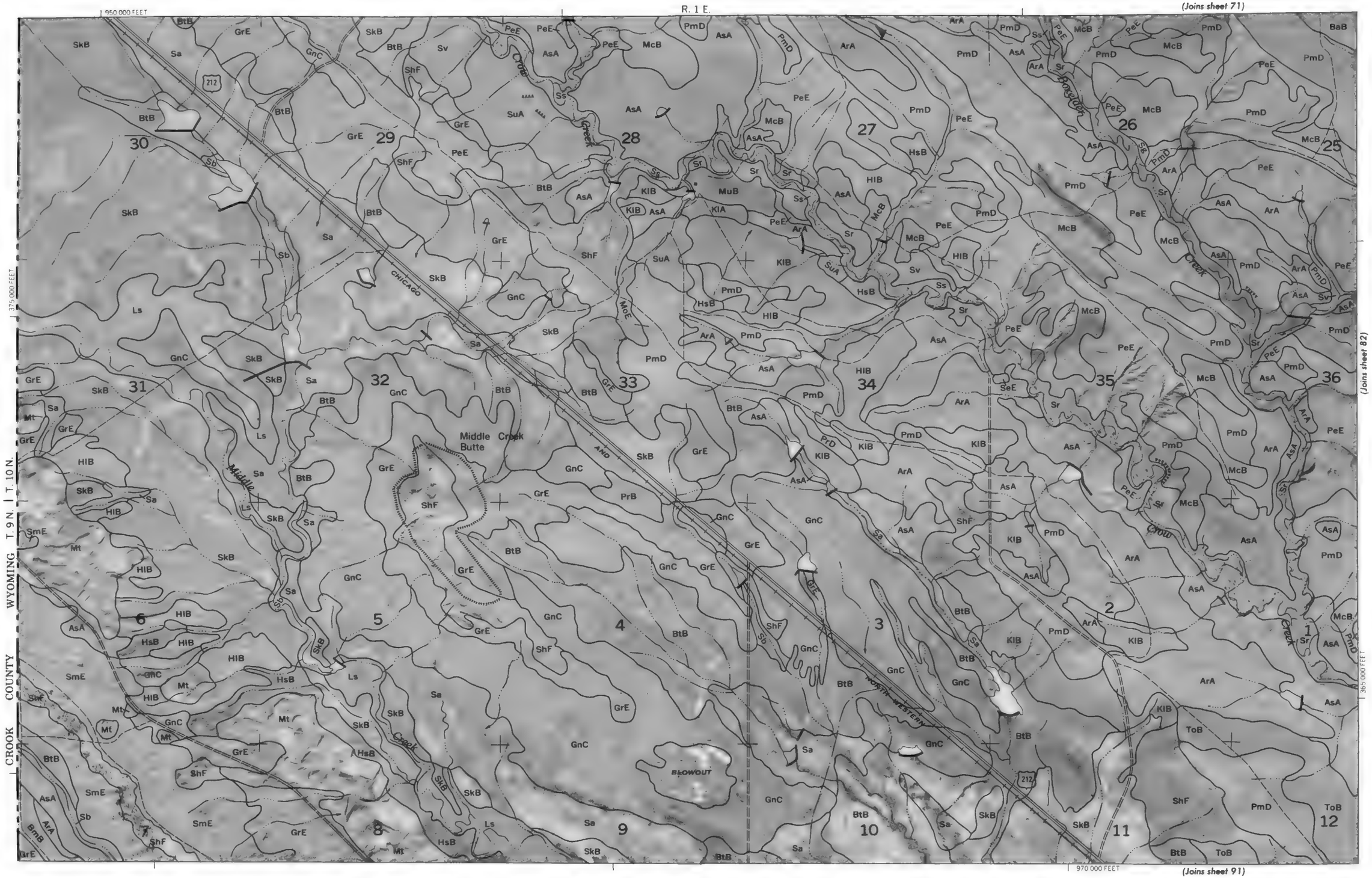
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

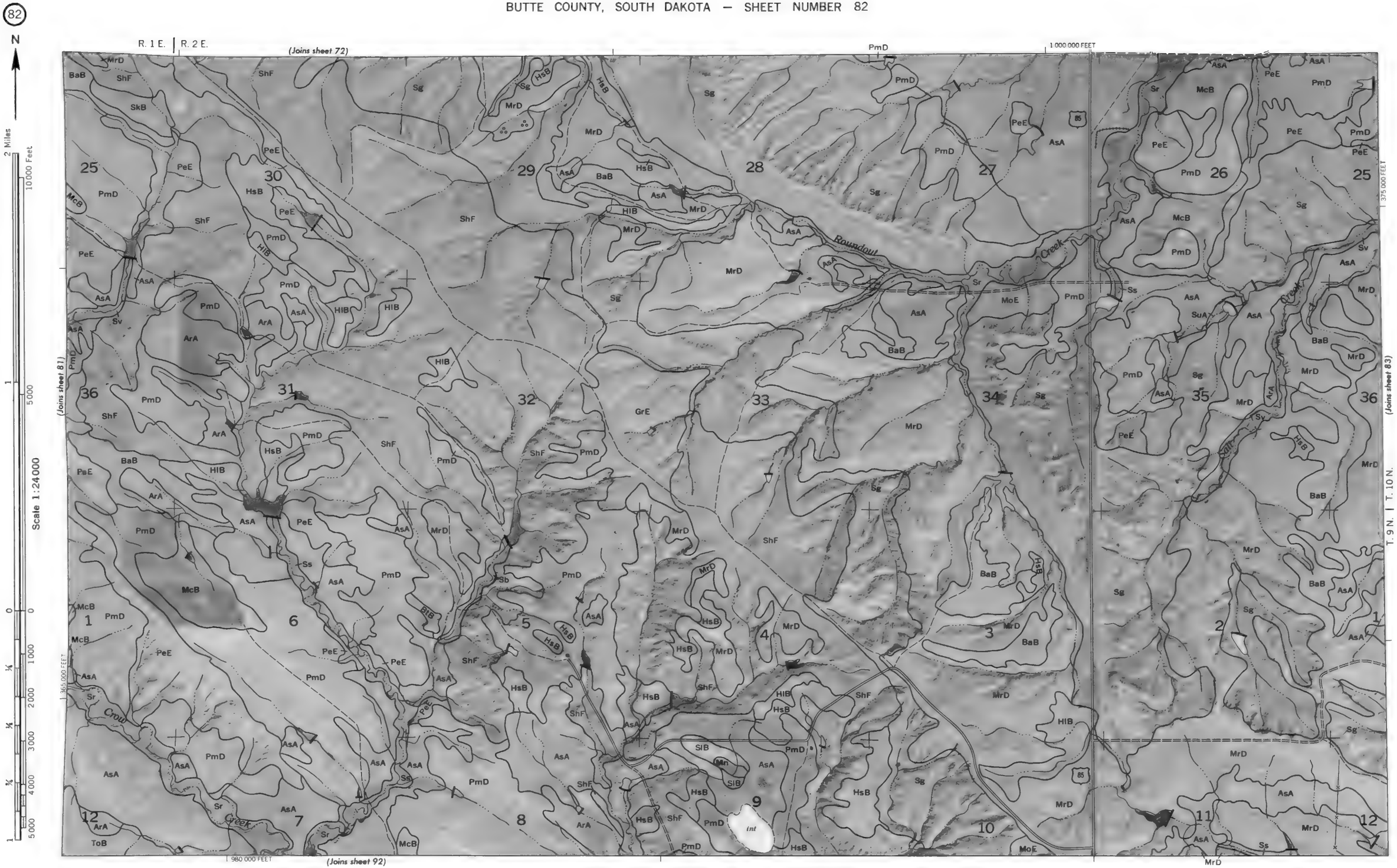
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 80

BUTTE COUNTY, SOUTH DAKOTA NO. 81

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.



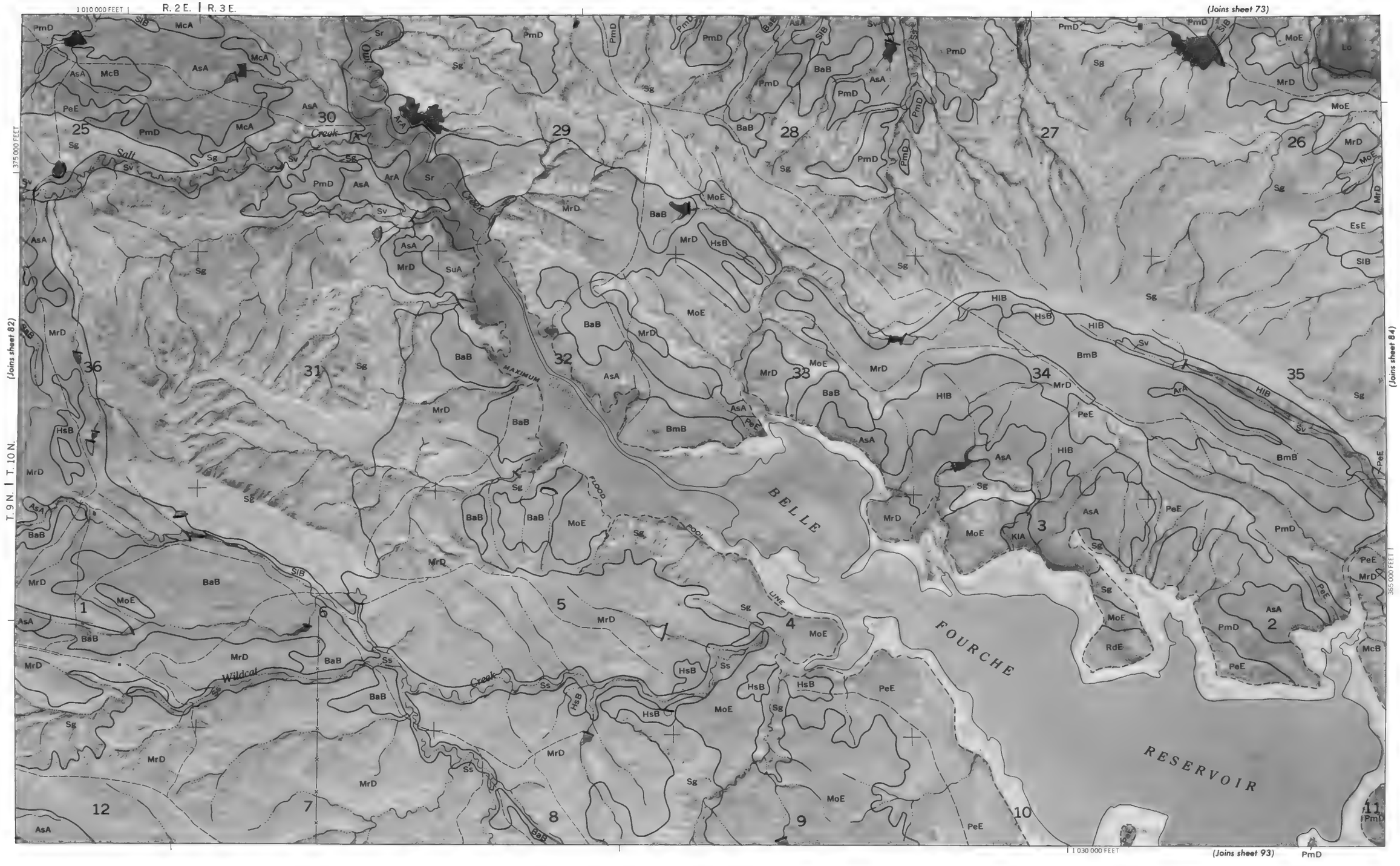


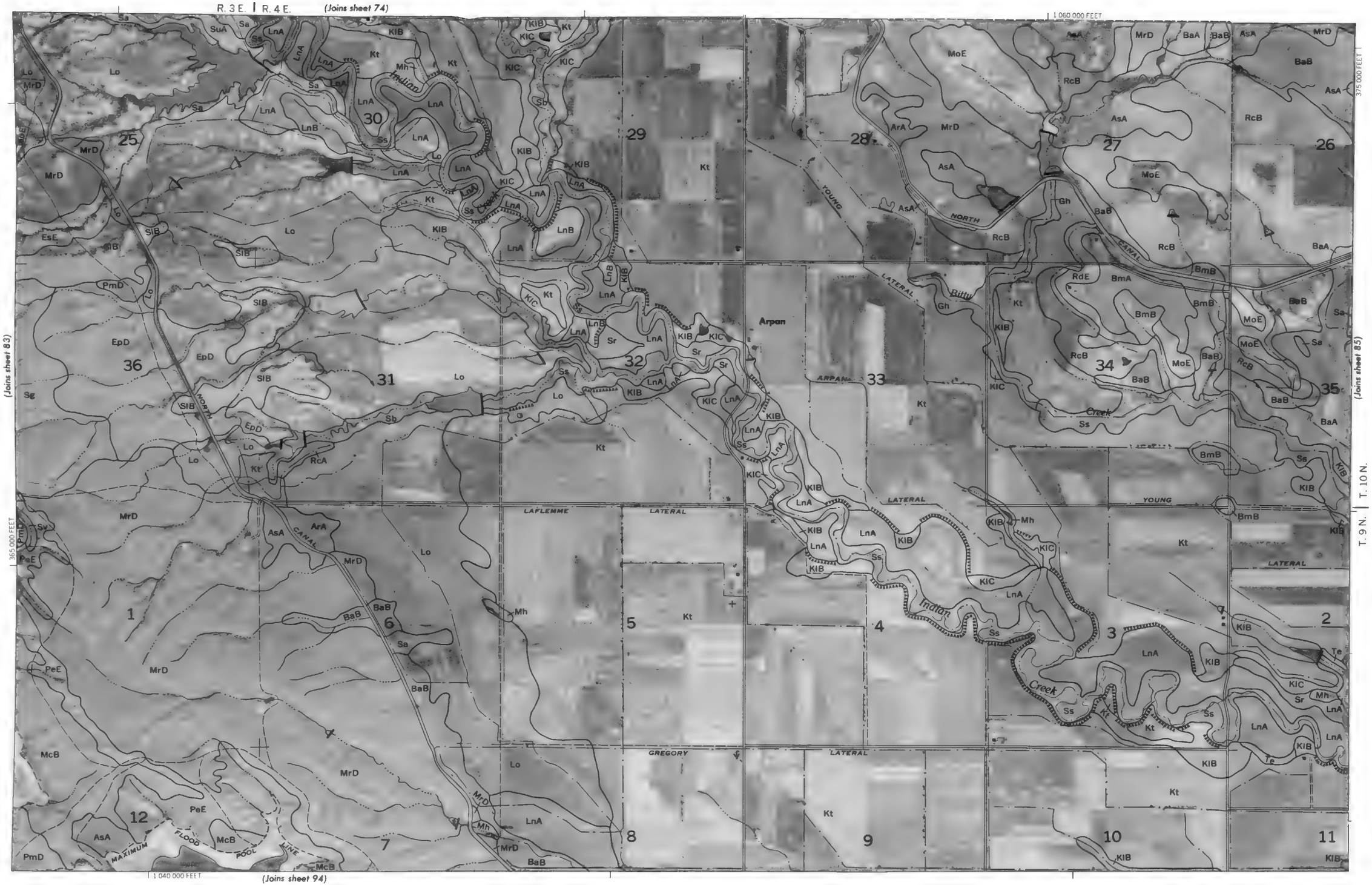
This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

BUTTE COUNTY, SOUTH DAKOTA NO. 82

BUTTE COUNTY, SOUTH DAKOTA NO. 83

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map





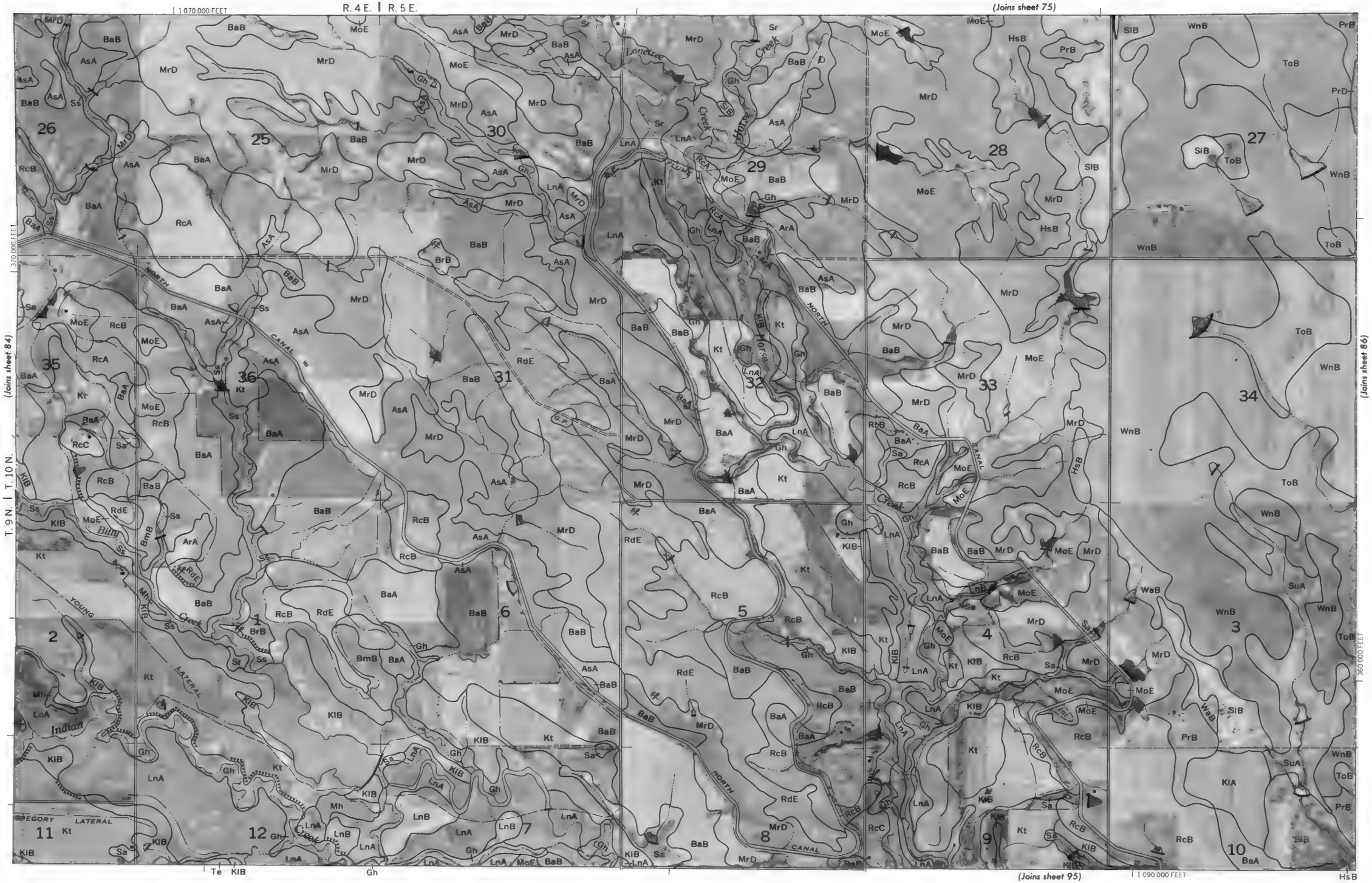
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 85

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone
Land division corners are approximately positioned on this map



N

(Joins sheet 76)

R. 5 E. | R. 6 E.

1 120 000 FEET

370 000 FEET

(Joins sheet 85)

360 000 FEET

1 100 000 FEET

(Joins sheet 96)

(Joins sheet 87)

T. 9 N. | T. 10 N.

2 Miles

10000 Feet

Scale 1:24000

5000

0

1000

2000

3000

4000

5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 86

BUTTE COUNTY, SOUTH DAKOTA NO. 87

This map is one of a set compiled on 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

R. 6 E. | R. 7 E.

1 130 000 FEET

370 000 FEET

T. 9 N. | T. 10 N.

(Joins sheet 77)

(Joins sheet 86)

(Joins sheet 88)

(Joins sheet 97)

1 150 000 FEET

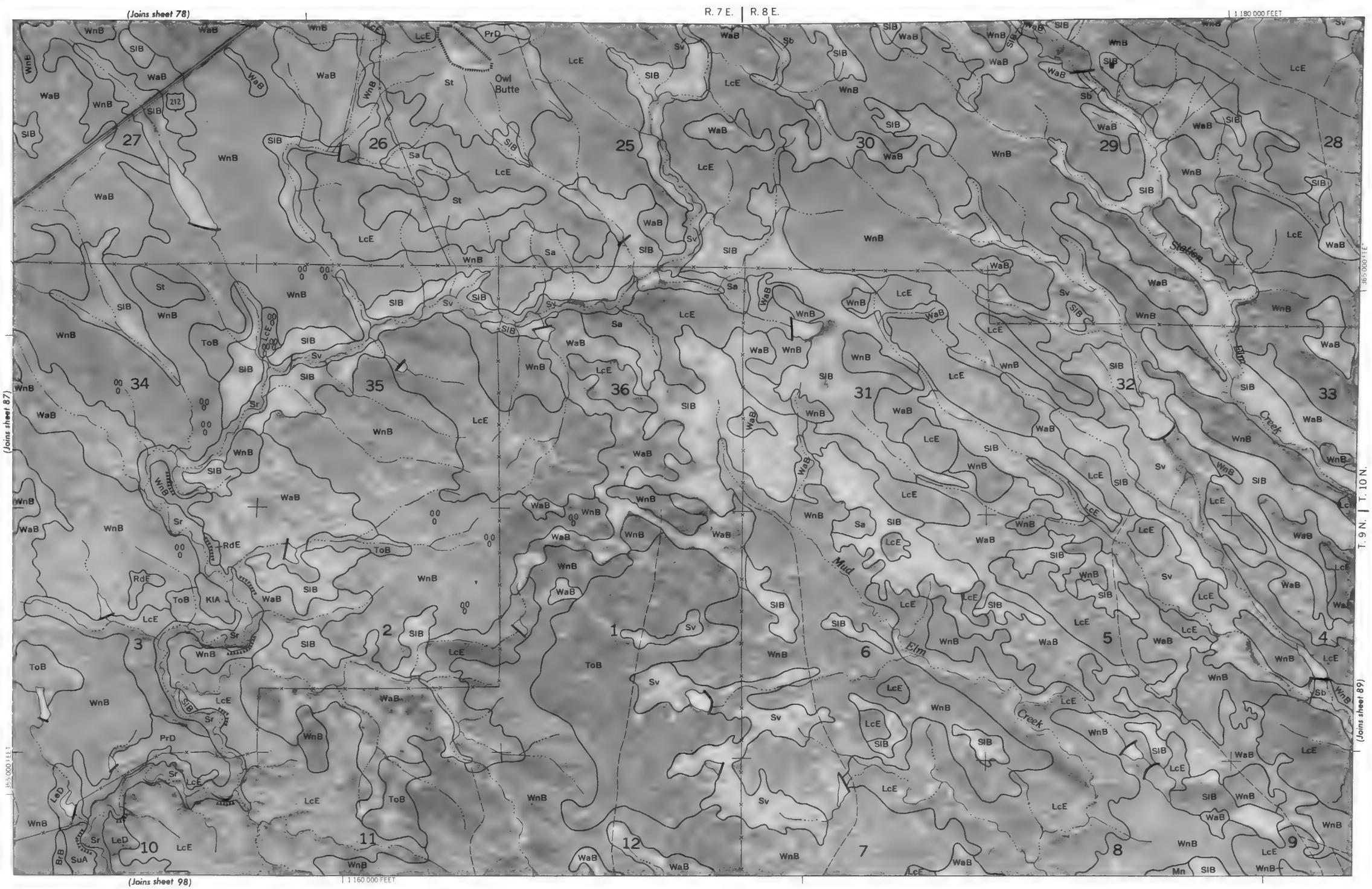
360 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000



2 Miles 1 0 10000 Feet

Scale 1:24000

5000 0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 88

BUTTE COUNTY, SOUTH DAKOTA NO. 89

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

1 190 000 FEET

R. 8 E. | R. 9 E.

(Joins sheet 79)

365 000 FEET

T. 9 N. | T. 10 N.

(Joins sheet 88)

(Joins sheet 90)

355 000 FEET

PrD HsB (Joins sheet 99)

1 210 000 FEET

N

2 Miles

10000 Feet

1

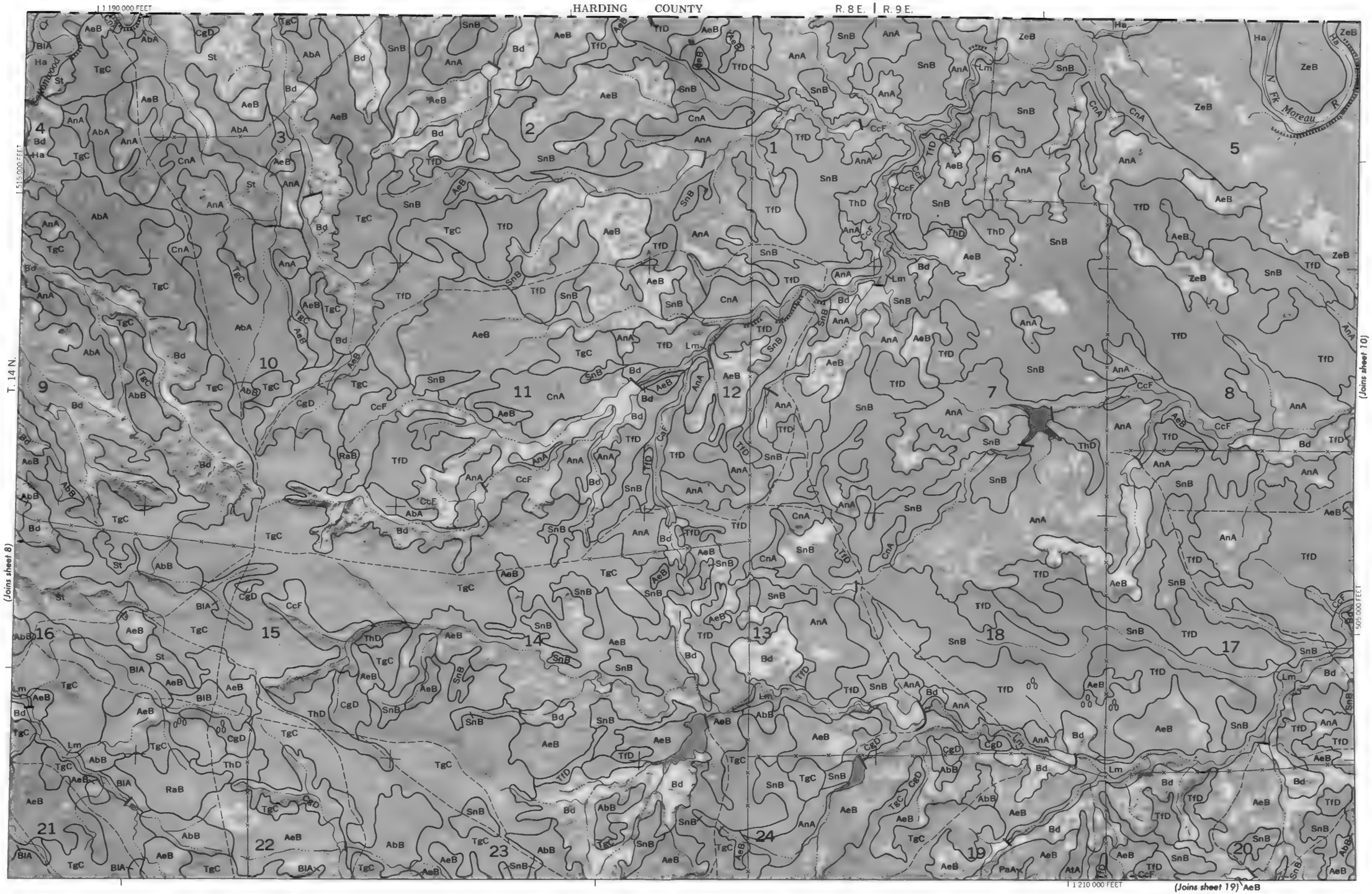
5000

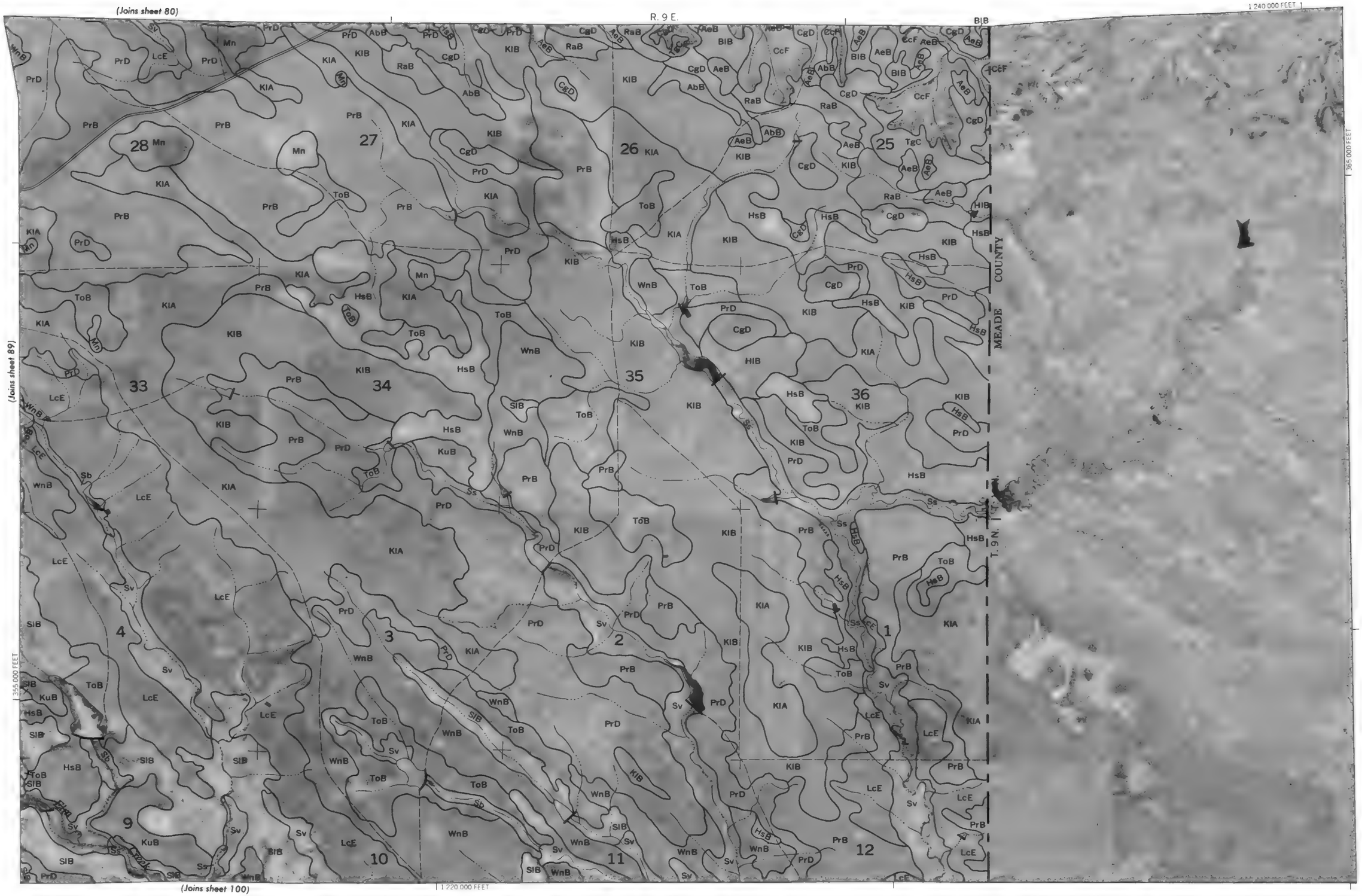
Scale 1:24000

0 1000 2000 3000 4000 5000

BUTTE COUNTY, SOUTH DAKOTA NO. 9

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map





N

2 Miles

10000 Feet

Scale 1:24000

5000

0

1000

2000

3000

4000

5000

Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 90

BUTTE COUNTY, SOUTH DAKOTA NO. 91

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

92

N

R. 1 E. | R. 2 E.

(Joins sheet 82)

1 000 000 FEET

T. 9 N.

(Joins sheet 91)

(Joins sheet 93)

(Joins sheet 102)

980 000 FEET

345 000 FEET

355 000 FEET

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

¼ 4000

5000

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

BUTTE COUNTY, SOUTH DAKOTA NO. 93

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map

R. 2 E. | R. 3 E.

1 010 000 FEET

T. 9 N.

365 000 FEET

(Joins sheet 92)

(Joins sheet 83)

(Joins sheet 94)

(Joins sheet 103)

1 030 000 FEET

345 000 FEET

BELLE FOURCHE RESERVOIR

MAXIMUM FLOOD POOL LINE

Susie Peak

Dry Creek

INLET CANAL

BELLE FOURCHE RIVER

N

Scale 1:24000

2 Miles 1 0 10000 Feet 5000

¼ ¼ ¼ ¼ 1 0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 95

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.
Land division corners are approximately positioned on this map.

1 070 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 85)

T. 9 N.

1 350 000 FEET

(Joins sheet 94)

(Joins sheet 96)

340 000 FEET

(Joins sheet 105)

1 090 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

N

Scale 1:24000

2 Miles 10000 Feet 5000 0

1 ½ 0 1000 2000 3000 4000 5000

R. 5 E. | R. 6 E.

T. 9 N.

1 120 000 FEET

1 100 000 FEET

340 000 FEET

350 000 FEET

(Joins sheet 86)

(Joins sheet 95)

(Joins sheet 106)

(Joins sheet 97)

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone

This map is one of a set compiled in 1974 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the South Dakota Agricultural Experiment Station.

BUTTE COUNTY, SOUTH DAKOTA NO. 97

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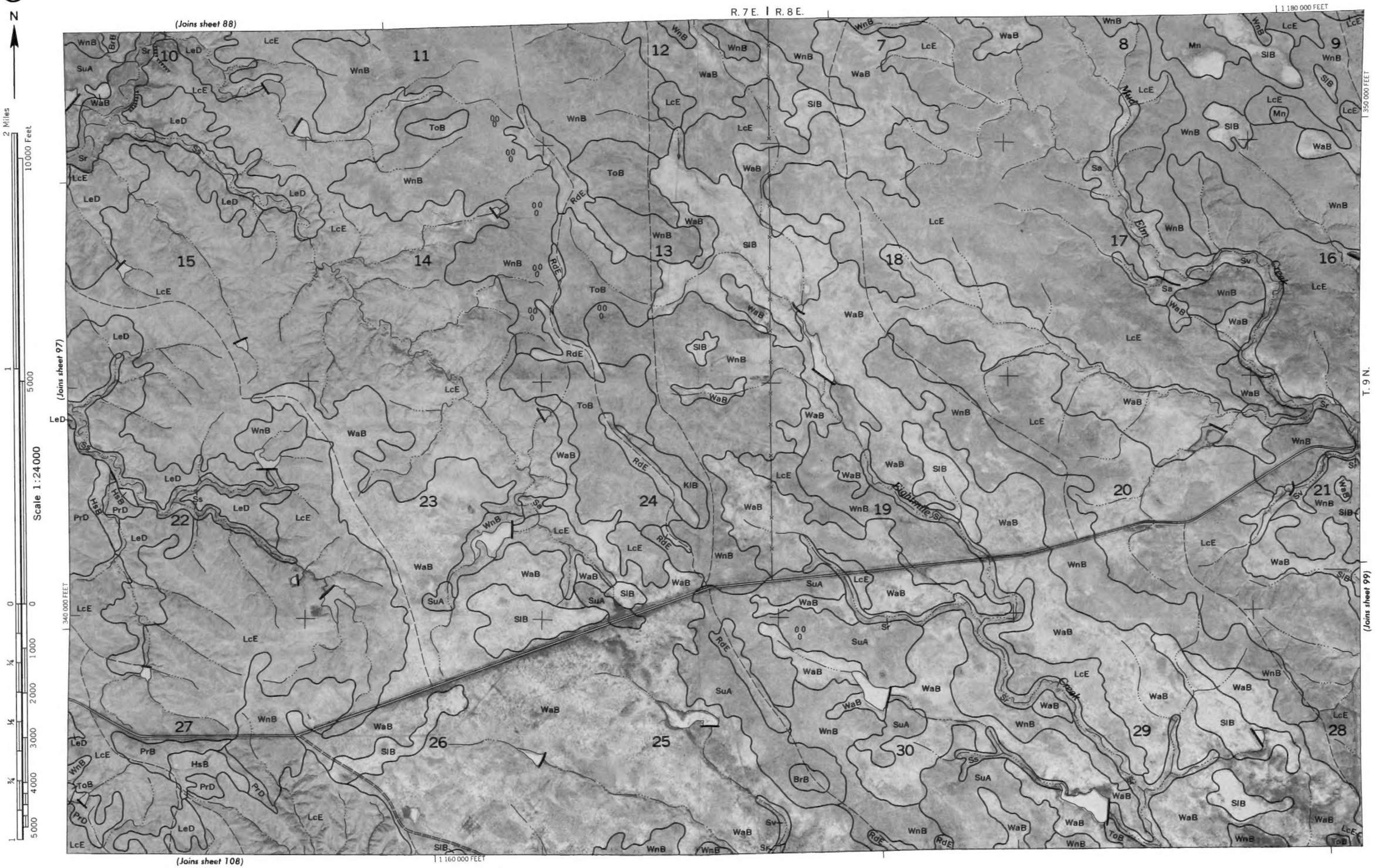

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the South Dakota coordinate system, north zone.

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BUTTE COUNTY, SOUTH DAKOTA NO. 98

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